FURUNO®

INSTALLATION MANUAL
AUTOPILOT FAP-300

This manual provides the information necessary for the installation of the FURUNO FAP-300 Autopilot. For best results, install the unit by following the enclosed instructions in the order presented.

The installation of this unit requires certain electrical and mechanical skills. Any purchaser who has doubts about his or her technical abilities may wish to have this unit installed by a FURUNO representative or other qualified technician. Without a proper installation, no machine can perform its intended functions.

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⚠ SAFETY INSTRUCTIONS

"**DANGER**", "**WARNING**" and "**CAUTION**" notices appear throughout this manual. It is the responsibility of the installer of the equipment to read, understand and follow these notices. If you have any questions regarding these safety instructions, please contact a FURUNO agent or dealer.

⚠ **DANGER**	This notice indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **WARNING**	This notice indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION**	This notice indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or property damage.

⚠ WARNING



Turn off the power at the mains switchboard before beginning the installation. Post a sign near the switch to indicate it should not be turned on while the equipment is being installed.

Fire, electrical shock or serious injury can result if the power is left on or is applied while the equipment is being installed.

⚠ CAUTION



Ground the equipment to prevent electrical shock and mutual interference.

Confirm that the power supply voltage is compatible with the voltage rating of the equipment.

Connection to the wrong power supply can cause fire or equipment damage. The voltage rating appears on the label at the rear of the display unit.

Use the correct fuse.

Use of a wrong fuse can cause fire or equipment damage.

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1. SYSTEM CONFIGURATIONS

1. Hydraulic steering boat with engine pump

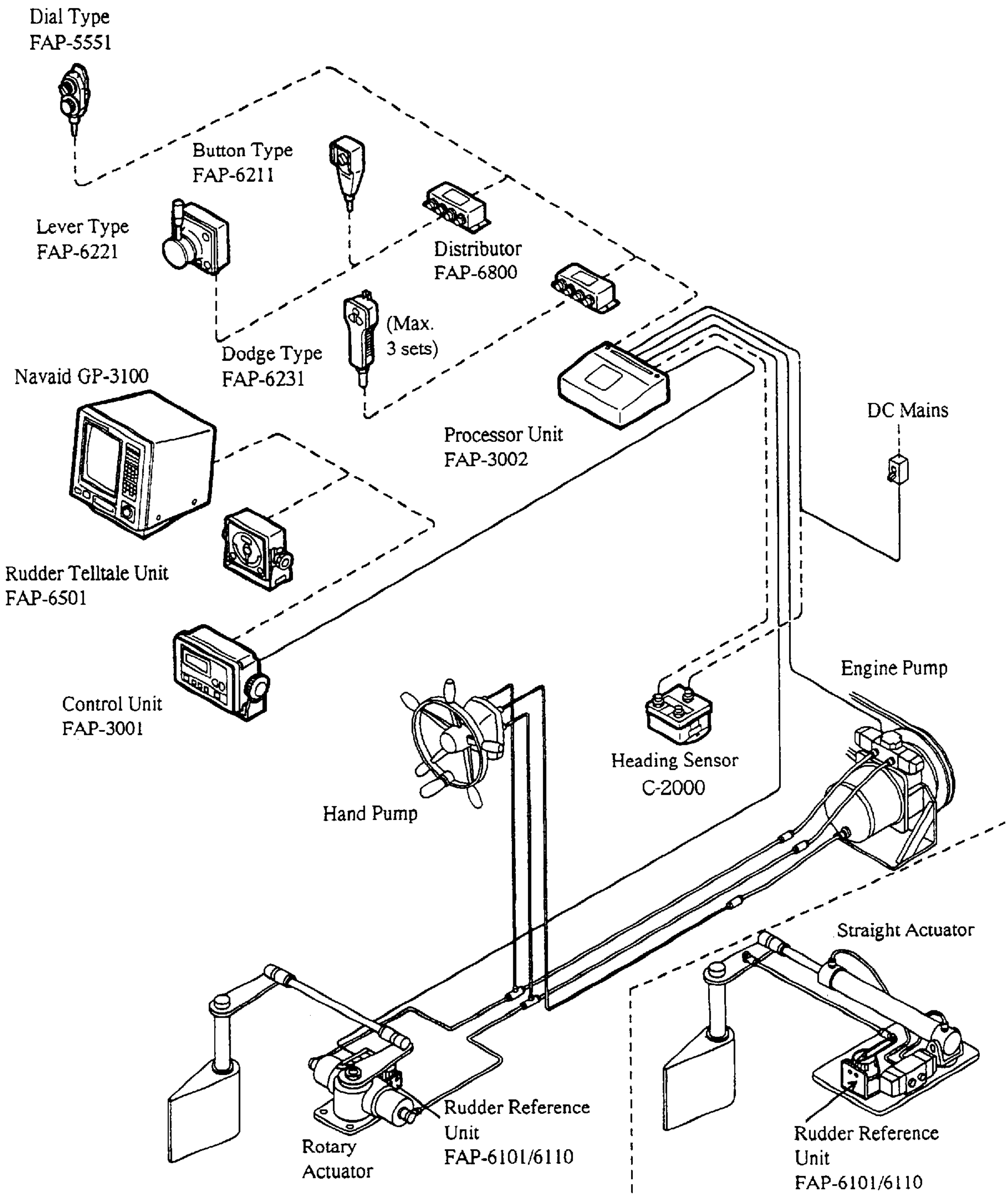


Fig. 1-1 Autopilot installation on hydraulic steering boat with engine pump

2. Hydraulic steering boat with engine pump and valve unit

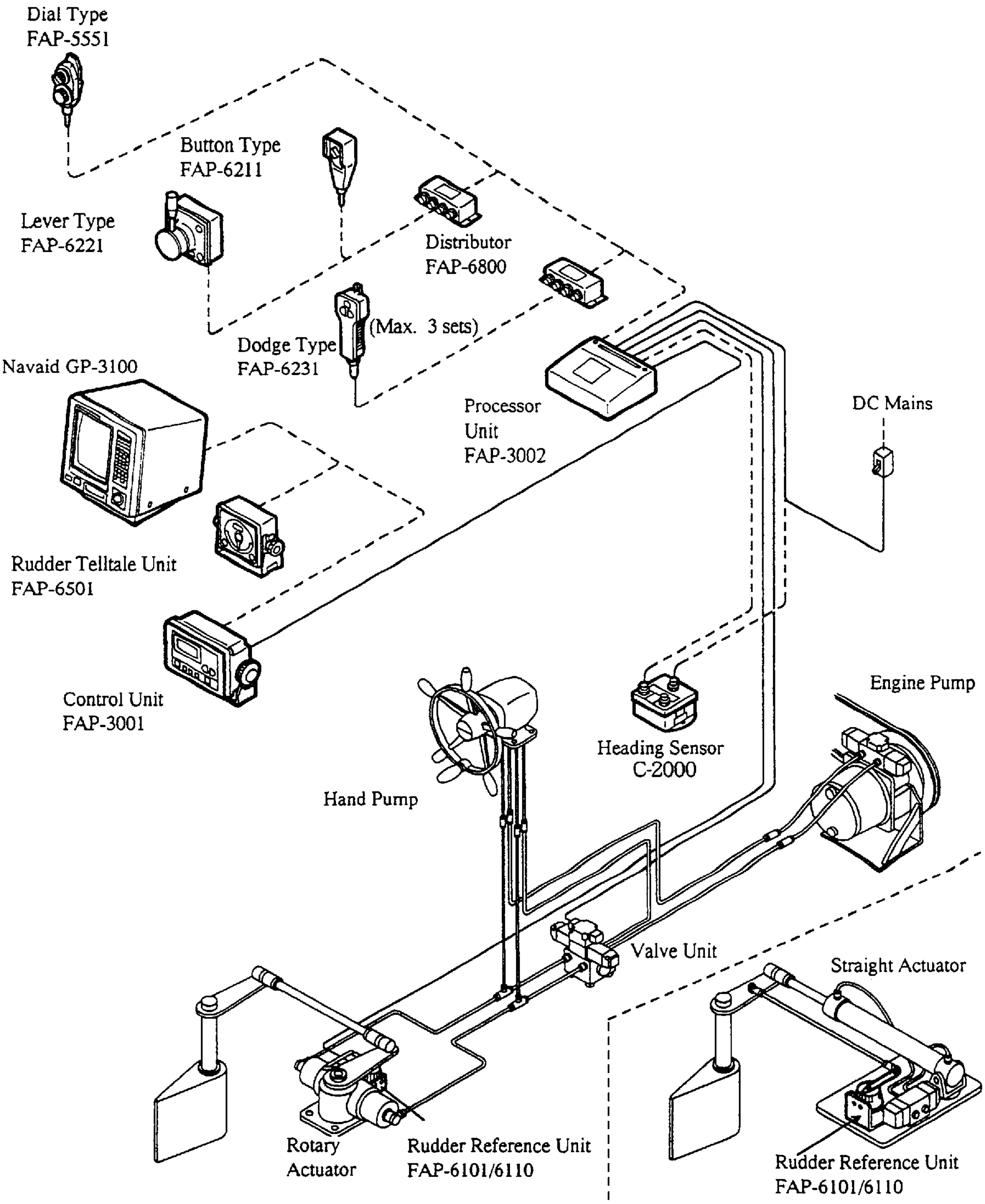


Fig. 1-2 Autopilot installation on hydraulic steering boat with engine pump and valve unit

3. Hydraulic steering boat with motor pump

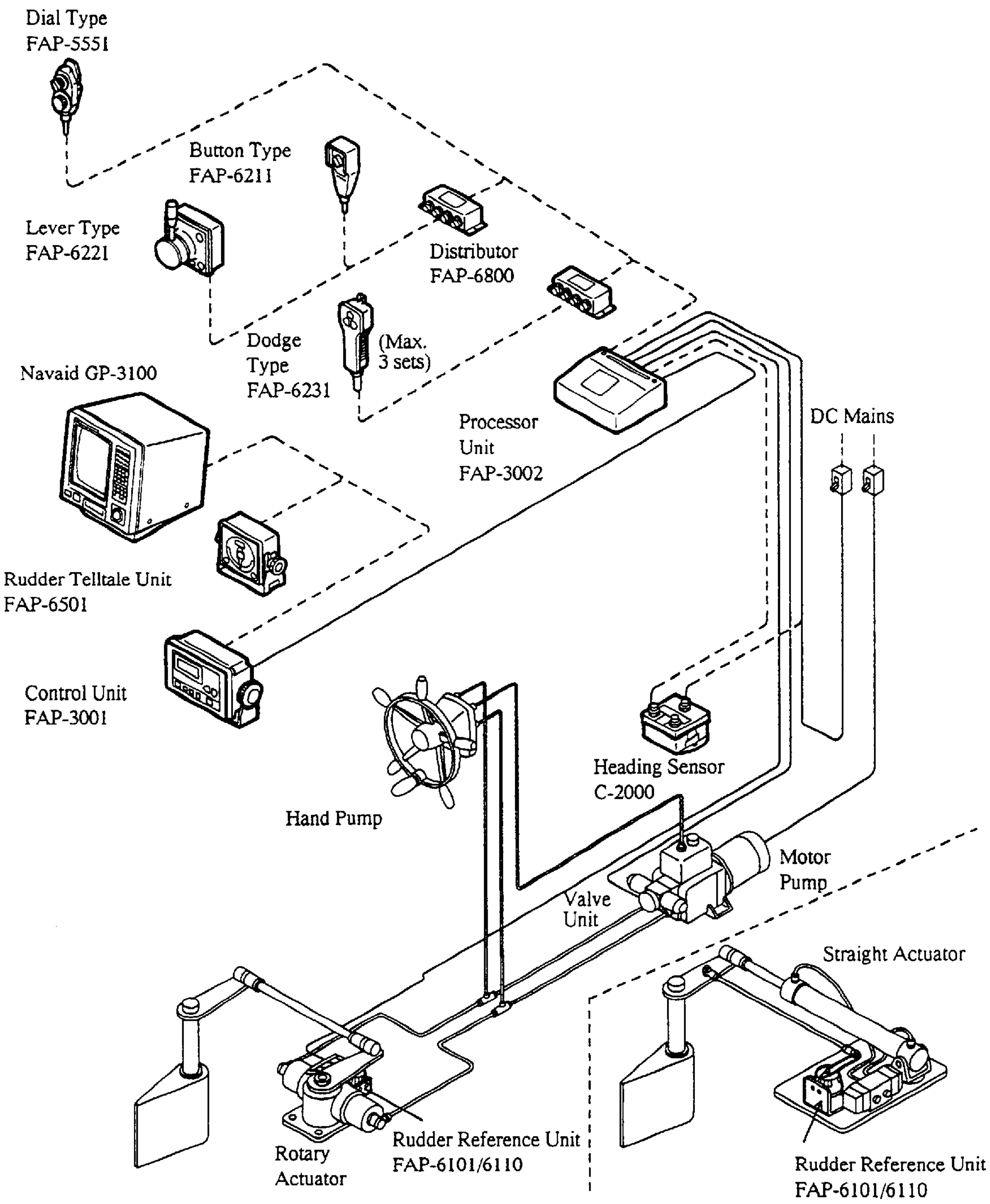


Fig. 1-3 Autopilot installation on hydraulic steering boat with motor pump

2. INSTALLATION OF UNITS

1. Installation Guidelines

Mounting considerations

When selecting mounting locations keep in mind the following points:
- Locate units away from direct sunlight.
- Select a location free of water splash and rain.
- Locate units away from direct air from air conditioner and heater.
- The location should be well ventilated.
- The temperature and humidity should be moderate and stable.

Notes on Cabling

1. Connect cables as shown in the interconnection diagram.

2. The power cable supplied with the FAP-300 is 5 meters long. It should run between the power supply (battery) and the processor unit via a circuit breaker (3A fuse incorporated) and be as short as practical. If a longer cable is required a larger wire size is necessary to minimize voltage drop.

   Under no circumstance should the Processor Unit share the same power cable with other equipment; ship's power lines are notorious for being "dirty" electrically. The voltage can vary greatly as various heavy loads are placed on the line, and the power wiring is a prime source for interfering electrical signals (from such sources as alternators or generators, and other electronics equipment, like radars or echosounders).

3. All signal cables should be separated (not parallel) as far as possible from cables carrying rf (radio frequency) or pulsed signals. At least one meter (three feet) separation is recommended.

4. The supplied cables should not be lengthened. Otherwise the performance of the unit will be reduced.

2. Rudder Reference Unit (FAP-6101/FAP-6110)

Mounting considerations

- Leave sufficient space around all moving parts.

- The unit must be coupled to the rudder as shown on page D-10, where the following conditions are satisfied:

FAP-6101:	Y2 < 600 mm	FAP-6110:	Y2 < 350 mm
	X1 = X2		X1 = X2
	Y1 = Y2		X1 = Y2

- When the rudder is in neutral position:
  - The Rudder Reference Unit should also be neutral (centered).
  - The arm of Rudder Reference Unit should be at a right angle to the tie rod.
  - The rudder stock should be perpendicular with the tie rod.
- After completing the installation, coat both ends of the tie rod with grease.

Mounting the unit on the same side as rudder

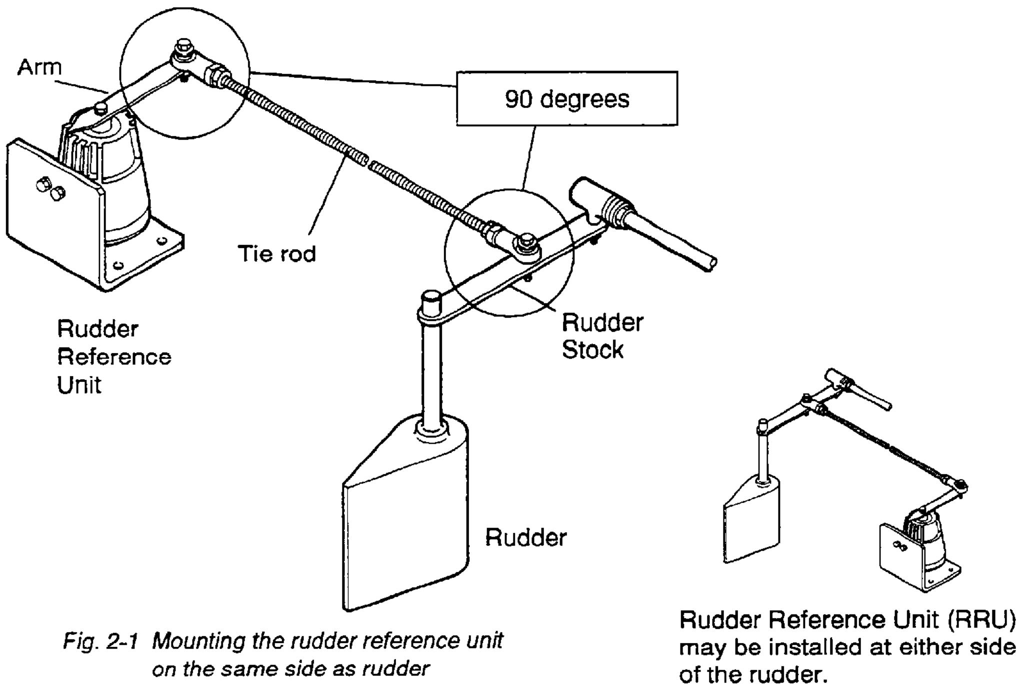


Fig. 2-1 Mounting the rudder reference unit on the same side as rudder

Mounting on the side opposite to rudder

When installing the Rudder Reference Unit on the side opposite to the rudder as shown below, change the wire connection. Open the bottom plate of the Rudder Reference Unit and exchange the brown and yellow wires at J6 on CPU Board. Refer to the figure on the next page.

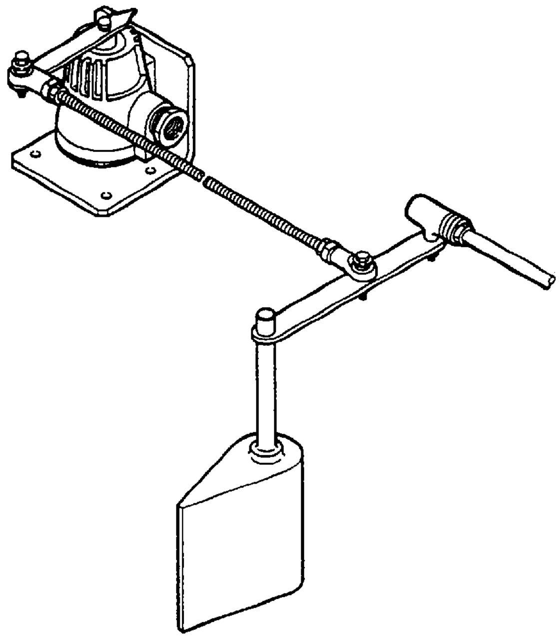


Fig. 2-2 Mounting the RRU on the side opposite to rudder

CAUTION

Install the Rudder Reference Unit on the same side as the rudder when the rudder angle limitation inherent in the boat's structure is more than 45 degrees.

Steering the rudder more than 45 degrees with the unit installed on the side opposite to the rudder may exceed the turning limit of the arm, damaging the unit.

Connections

- Rudder Reference Unit on same side as rudder

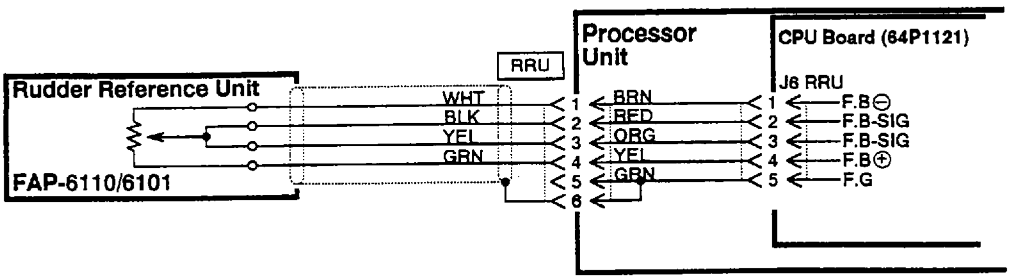


Fig. 2-3 Connections when the rudder reference unit is installed on same side as rudder.

• Rudder Reference Unit on side opposite to rudder

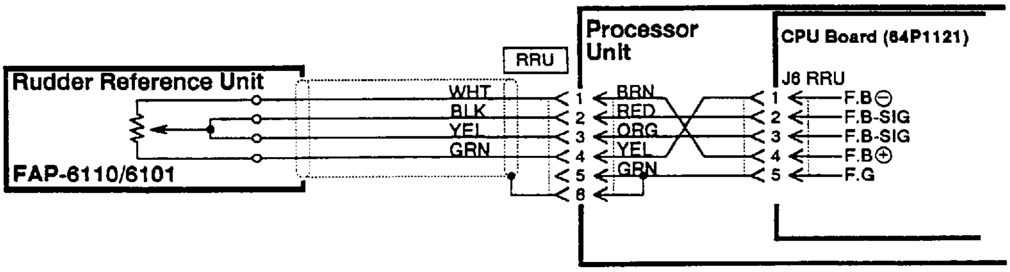


Fig 2-4 Connections when the rudder reference unit is installed on side opposite to rudder.

3. Remote Controller

To hand-hold FAP-5551

If you desire handheld operation invert the switch and dial so that they are readable. This can be done by unfastening the four screws shown below. Note that the switch and dial are inserted into the controller body with O-rings. Be careful not to damage the O-rings.

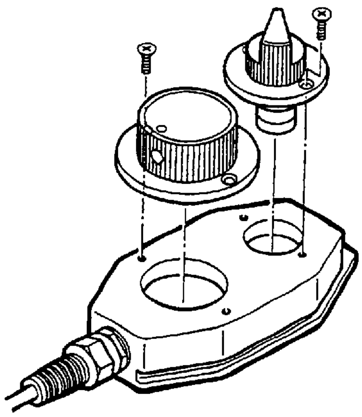


Fig. 2-5 Inversing the switch and dial on the FAP-5551

To use multiple non-follow-up-type remote controllers

The Distributor FAP-6800 enables connection of three NFU (Non-Follow-Up)-type remote controllers to the Processor Unit. Note that only one FU (Follow-Up)-type remote controller may be connected.

Example connections

FAP-5551 dial-type remote controller

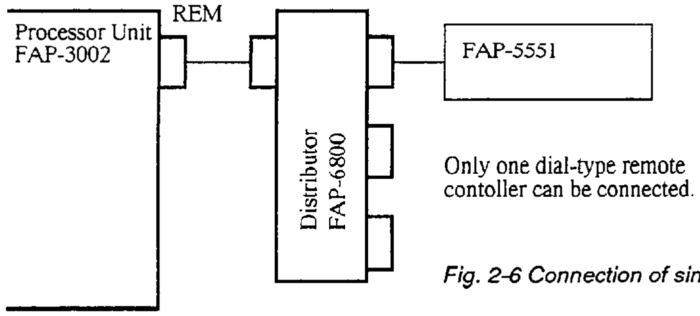


Fig. 2-6 Connection of single dial type remote controller

FAP-6211 or FAP-6221 button/lever-type remote controllers

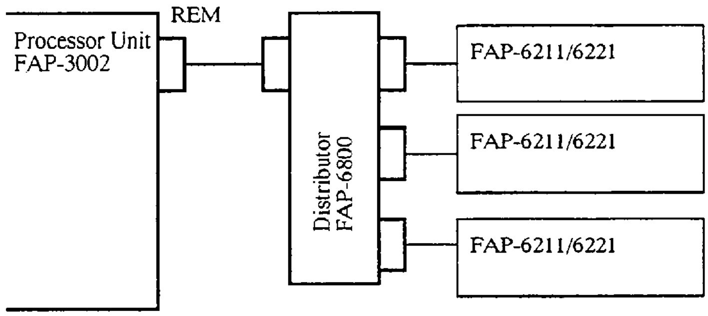


Fig. 2-7 Connection of three button/lever- type remote controllers

FAP-6231 dodge-type remote controller

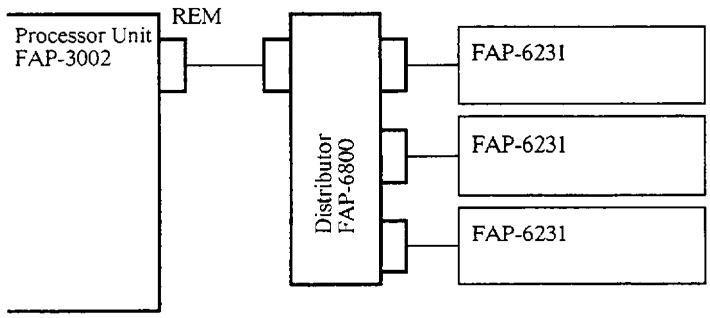


Fig. 2-8 Connection of three dodge-type remote controllers

The following connections are not possible.

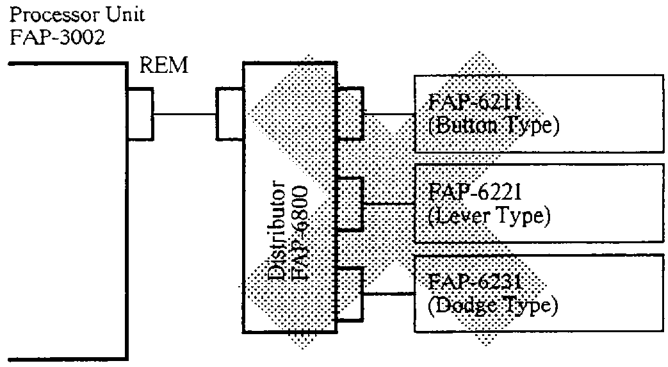


Fig. 2-9 Different types of remote controllers cannot be connected

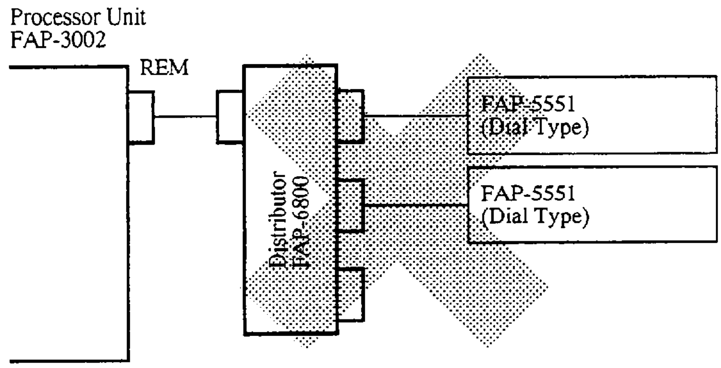


Fig. 2-10 Only one dial type can be connected

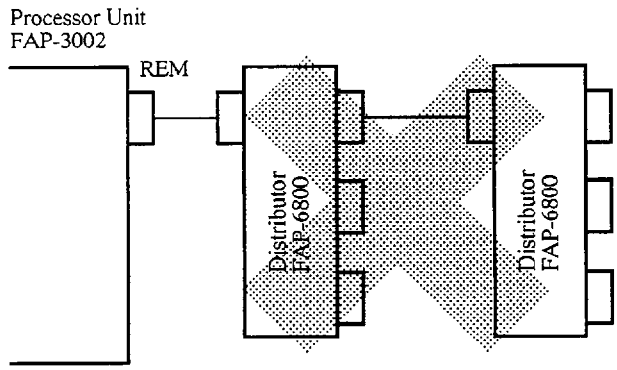


Fig. 2-11 Multiple distributors cannot be connected

Receiving autopilot data

The FAP-300 can output autopilot data to either the GD-3100/GP-3100 Video Plotters or the FAP-6501, through pins #3 and #4 of the DATA IN/OUT connector. The unit to output data to is determined by the setting of Jumper JP1 on the I/F Board in the Control Unit. To output data to the FAP-6501, cut the pattern and attach a jumper wire. See Fig.2-12.

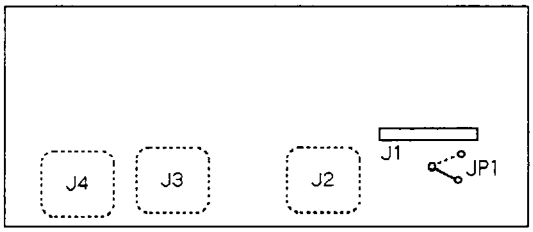


Fig. 2-12 Location of jumper JP1on I/F board in Control Unit

Data output to	Jumper JP1
GP-3100 or GD-3100	No modification necessary (default setting).
FAP-6501	Referring to Fig. 2-12, cut pattern (solid line) and attach jumper wire (dashed line).

Connection of power supply

The FAP-6501 requires an external power supply whose output voltage is 10.8 to 30Vdc. Connect the power supply to the FAP-6501 as shown in Fig. 2-13.

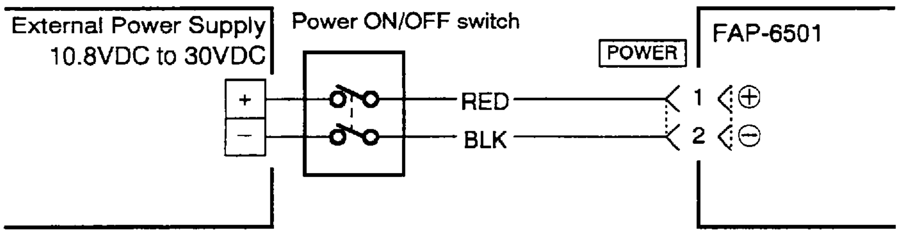


Fig. 2-13 Connection of power supply to the FAP-6501

Connection

- Connection of Control Unit only

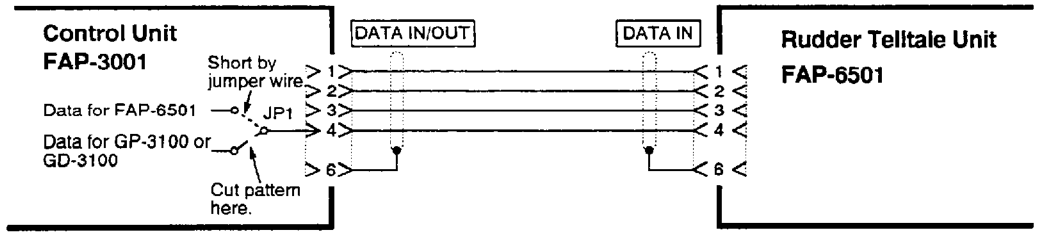


Fig. 2-14 Connecting FAP-6501 to FAP-3001

- Connection of Control Unit and navaid

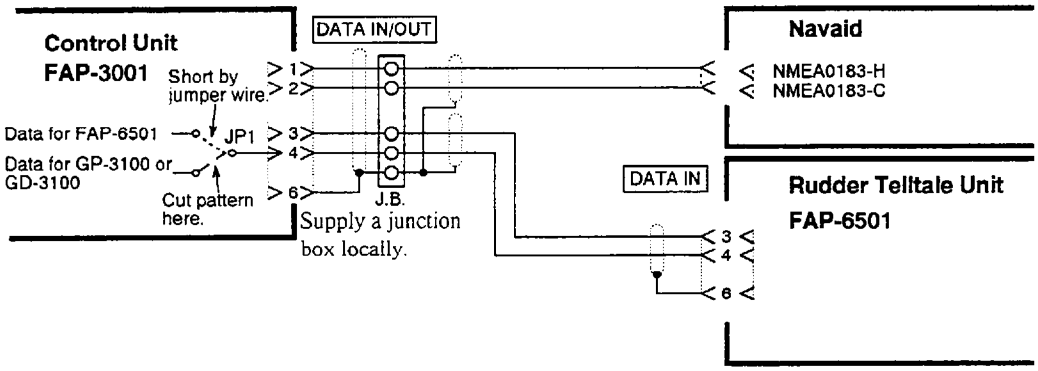


Fig. 2-15 Connecting FAP-6501 and navaid to FAP-3001

Multiple unit installation

A maximum of three Rudder Telltale Units may be connected in series as shown in Fig. 2-16.

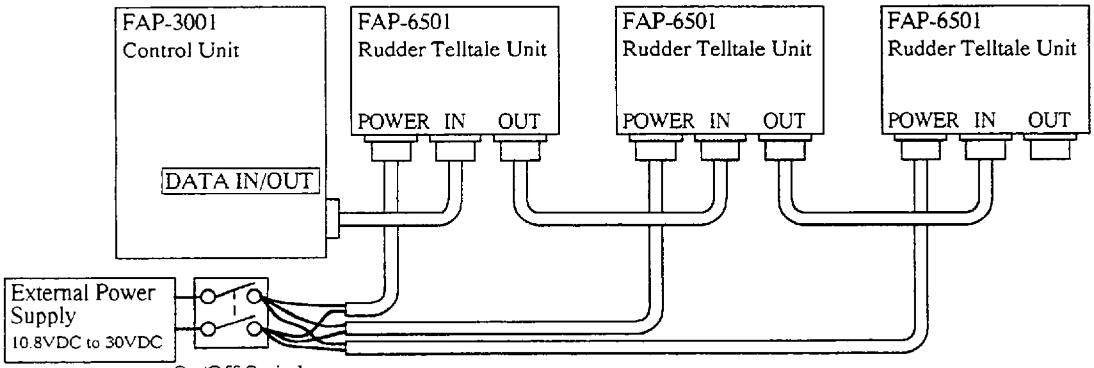


Fig. 2-16 Multiple rudder telltale unit installation

5. Color Plotter GP-3100 or GD-3100

Receiving autopilot data

The FAP-300 can output data to either the GD-3100/GP-3100 Video Plotters or the data to FAP-6501, through pins #3 and #4 of the DATA IN/OUT connector. The unit to output is determined by the setting of Jumper JP1 on the I/F Board in the Control Unit. The solid line of JP1 is shorted at the factory to connect the video plotter.

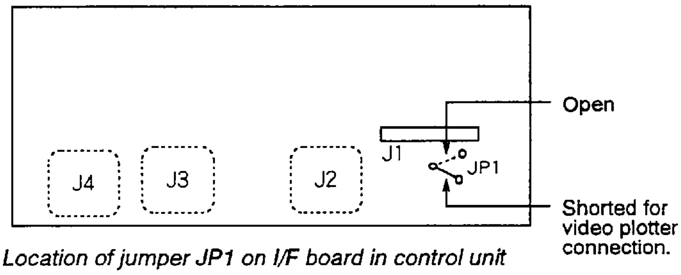


Fig. 2-17 Location of jumper JP1 on I/F board in control unit

Data output to	Jumper JP1
GP-3100 or GD-3100	No modification necessary (default setting).
FAP-6501	Referring to Fig. 2-17, cut pattern (solid line) and attach jumper wires (dashed line).

Connections

Connect GP-3100 or GD-3100 to the Control Unit as shown in Fig. 2-18.

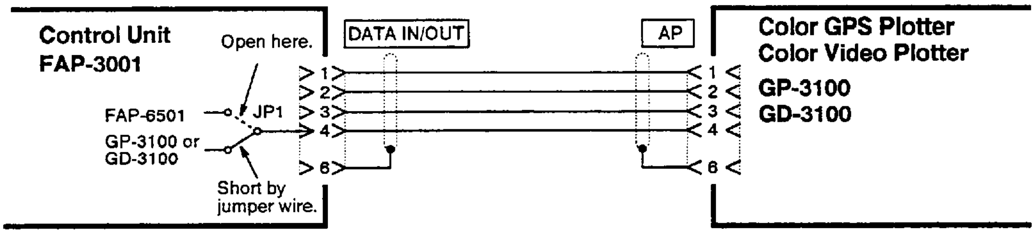


Fig. 2-18 Connecting GP-3100 or GD-3100 to FAP-3001

3. SETTING DIP SWITCHES AND JUMPERS

This chapter describes how to set up the the FAP-300 according to usages desired, by presetting DIP switches and jumpers. Adjustment may not be necessary depending on setting desired. Section 12 of this chapter (page 22) lists default settings for DIP switches and jumpers. Refer to it to determine if adjustment is necessary. Before changing any settings, turn off the power.

1. Location of DIP switches and jumpers

DIP switch in control unit

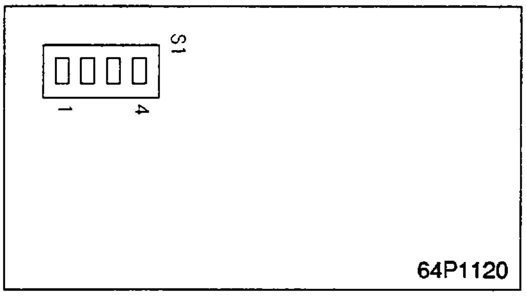


Fig. 3-1 Location of the DIP switch on LCD board in control unit

DIP switch and jumpers in processor unit

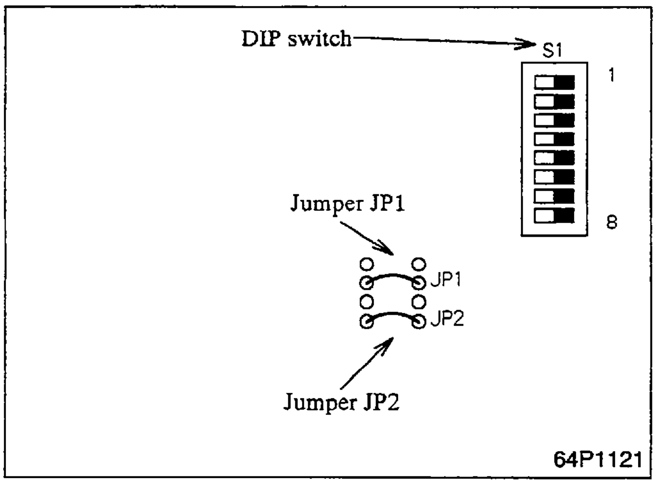


Fig. 3-2 Location of the DIP switch and jumpers on CPU board in processor unit

2. Selecting item to display on analog (bar) indication

Introduction

The default setting shows rudder angle, course deviation or cross-track error depending on the steering mode. When only rudder angle is needed, the indication may be fixed for rudder angle.

Procedure

Set the #1 switch of the DIP switch on the LCD Board (64P1120) in the Control Unit according to item to display on the analog indication.

Item to display on analog indication	Segment 1
Rudder angle, Course deviation or Cross-track error depending on the steering mode	OFF
Rudder angle only irrespective of the steering mode	ON

3. Selecting item to display on HEADING/COURSE indication

Introduction

The default setting shows heading or course depending on the steering mode. When only course is needed, the indication may be fixed for course.

Procedure

Set the #2 switch of the DIP switch on the LCD Board (64P1120) in the Control Unit according to item to display on HEADING/COURSE indication.

Item to display on HEADING/COURSE indication	Segment 2
Heading or course depending on the steering mode	OFF
Course only irrespective of the steering mode	ON

4. Registering the type of remote controller

Introduction

When a remote controller is connected, register the type.

Procedure

Set the #1 and #2 switches of the DIP switch on the CPU Board (64P1121) in the Processor Unit according to type of remote controller connected.

Type of remote controller connected	Segment 1	Segment 2
FAP-5551	OFF	OFF
FAP-6211	ON	OFF
FAP-6221	ON	OFF
FAP-6231	ON	ON

Do not disturb the settings of segments 1 and 2 when no remote controllers are installed.

5. Registering directional reference of heading data

Introduction

Register directional reference of heading sensor.

Procedure

Set the #3 switch of the DIP switch on CPU Board (64P1121) in the Processor Unit according to output of heading sensor.

Output of heading sensor	Segment 3
Magnetic bearing	OFF
True bearing (Gyrocompass)	ON

6. Reducing the number of sea state settings to use

Introduction

The FAP-300 can register three sets of steering characteristics to meet various sea conditions. They are SEA STATE ①, ② and ③. When the sea condition does not change much and changing of the sea state number is not necessary, you may reduce the number of sea state settings to use to one.

Procedure

Set the #4 switch of the DIP switch on CPU Board (64P1121) in the Processor Unit according to number of sea state settings to use.

Number of sea state settings to use	Segment 4
Three	OFF
One	ON

When the number of sea states is reduced to one, the function of the SEA STATE key changes. Every pressing of the key enables adjustment of sea state. To escape from the sea state setting display, press the **ALARM RESET** key.

7. Enabling "Net towing AUTO mode"

Introduction

When a boat tows a net its stern is "dragged" by the net. This causes the boat to stray from its intended course. To keep the boat on course, you need to adjust the trim manually, which can be bothersome. If you do not want to be bothered with trim adjustments, you can enable the net towing AUTO steering feature. It is indispensable for trawlers.

Procedure

Turn on the #5 switch of the DIP switch on the CPU Board in the Processor Unit to enable this feature.

"Net Towing AUTO"	Segment 5
Disable	OFF
Enable	ON

8. Registering the function of the NAV mode

The function of the NAV mode can be one of the following.

Cross track error control

The default setting is "Cross track error control". The FAP-300 controls the boat to decrease the cross track error. The boat will follow the course between FROM and TO waypoints.

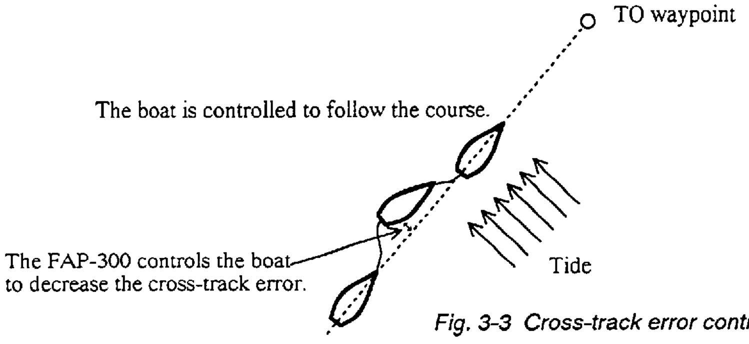


Fig. 3-3 Cross-track error control in the NAV mode

When the remote controller is turned off, FAP-300 controls the boat to return to the original course.

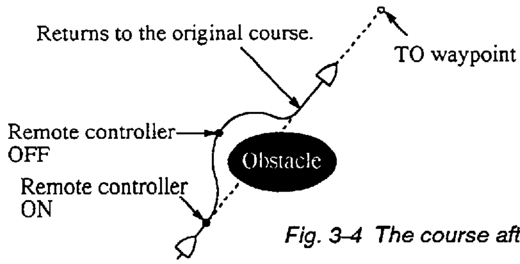


Fig. 3-4 The course after using remote controller

Course deviation control

The FAP-300 controls the boat to always head to the TO waypoint. The course for waypoint navigation is ignored.

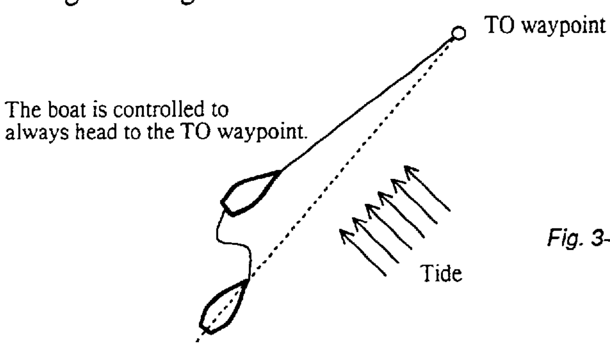


Fig. 3-5 Course deviation control in the NAV mode

The FAP-300 ignores the original course and directly heads to the TO waypoint. The boat will not return to the original course.

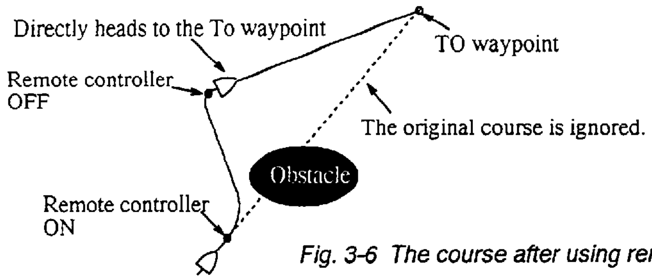


Fig. 3-6 The course after using remote controller

When connected to GP-3100 or GD-3100

When the FAP-300 is connected to GP-3100 or GD-3100, the function is "Cross-track error control". However, at the moment remote controller is turned off, the control is "Course deviation control". The GP-3100 or GD-3100 sets the new course when the remote controller is turned off.

Procedure

Set the #6 switch of the DIP switch on CPU Board (64P1121) in the Processor Unit according to NAV mode function desired.

NAV mode control	Segment 6
Cross track error control	OFF
Course deviation control	ON

9. Selecting the navaid for "Advanced AUTO mode"

Introduction

The navaid for the Advanced AUTO mode may be GP-3100 or GD-3100 or any navigational equipment transmitting GLL (NMEA0183). Connecting GP-3100 or GD-3100 enables smoother control of the boat.

Procedure

Set the #7 switch of the DIP switch on the CPU Board (64P1121) in the Processor Unit according to the navaid connected.

Navaid for "ADVANCED AUTO MODE"	Segment 7
GLL (NMEA 0183) outputting navaid	OFF
GP-3100 or GD-3100	ON

10. Setting the rudder angle limitation for AUTO mode

Introduction

Narrow the rudder angle limitation when you can not run the boat straightly in spite of the steering characteristics from the front panel for AUTO mode.

Procedure

Set Jumper JP1 on the CPU Board (64P1121) in the Processor Unit for desired rudder angle limitation.

Rudder limitation for AUTO and mode	Jumper JP1
10 degrees	Open
20 degrees	Short (Default)

11. Enabling watch alarm

Procedure

The watch alarm warns the helmsman to check the autopilot. To enable the watch alarm, open the Jumper JP2 on the CPU Board (64P1121) in the Processor Unit. To disable the watch alarm, short JP2.
Note that the watch alarm cannot be disabled from the front panel of the Control Unit; only the aural alarm can be silenced there.

"Watch alarm"	Jumper JP2
Enable	Open
Disable	Short

12. Default settings for DIP switches and jumpers

The default settings for the DIP switches and jumpers are as follows.

Control unit

Dip switch (64P1120)

Segment	Default
1	OFF
2	OFF
3	OFF
4	OFF

Jumper (64P1122)

Jumper	Default
JP1	shorted

Processor unit (64P1121)

Dip switch (64P1121)

Segment	Default
1	OFF
2	OFF
3	OFF
4	OFF
5	OFF
6	OFF
7	OFF
8	OFF

Jumper (64P1121)

Jumper	Default
JP1	Shorted
JP2	Shorted

4. NAVAID CONNECTION

1. NMEA 0183 sentences and the FAP-300

Immediately after turning on the power, the FAP-300 does the following.

(1) Collects nav. data for a certain period,
(2) Examines which of the following six sentences are contained in the collected data;

1. BWC+XTE	+VTG+AAM	+GLL
2. BOD+XTE	+VTG+AAM	+GLL
3. APB	+VTG	+GLL
4. RMB	+VTG	+GLL
5. APA	+VTG	+GLL
6. GLL		

NAV mode operation is possible without VTG (ship's speed) and AAM (arrival alarm). Inputting them however enables much smoother control of the boat. The GLL (position data) is required for the ADVANCED AUTO mode operation.

(3) The FAP-300 chooses the format with the highest priority. "1" to "6" are order of priority; 1 for highest, 6 for lowest.

The FAP-300 thereafter fetches only the data selected, until it is turned off.
For NAV mode operation, one of "1." to "5." is required.

NOTE *(If data with various talker IDs are received.):*

Talkers are prioritized in the order of GP-LC-DE-LA-TR-II. The FAP-300 examines all the incoming data for a certain period after power-on, then judges which has the highest priority. The FAP-300 thereafter picks up only the data with that talker ID until the power is turned off. Even if the data does not come for an extended period of time, the FAP-300 does not switch to a different talker ID because it is dangerous if data consistency is lost. Safety comes first!

5. CHECKS AFTER INSTALLATION

1. Function test

After installing the unit, conduct the following function test with the vessel moored in a harbor.

IMPORTANT

1. The FUNCTION TEST must be conducted by a person who has thorough knowledge of the autopilot's functions.
2. Make sure that there is no one nor any obstruction in the area near the rudder when perfoming the test.
3. If the rudder is driven continually, immediately turn off the FAP-300 or press [POWER ON STBY]. The FAP-300 may be faulty or not installed properly.

Procedure

(1) Turn off the FAP-300. Steer the wheel from hard over to hard over, then return it to neutral.	The rudder shall move smoothly without undue stiffness.
(2) Turn on the FAP-300 by pressing [POWER ON STBY].	The STBY mode indication "S" shall appear.
(3) Steer the wheel from hard over to hard over, then return it to neutral.	The rudder angle indication shall change accordingly.
(4) Compare the heading indication (digital) with the compass reading.	The heading indication shall be close to that of the compass reading.
(5) Press [AUTO].	The AUTO mode indication shall appear.
(6) By adjusting the course control, increase the course reading by 10 degrees in the starboard direction.	The analog meter shall indicate a 10 degree course change to starboard.

(7) Press [POWER ON STBY].

The analog meter shall indicate correct rudder angle in starboard direction.

(8) Press [AUTO].

(9) By adjusting the course control, decrease the course reading by 10 degrees in the port direction.

The analog meter shall indicate 10 degree course deviation to port.

(10) Press [POWER ON STBY].

The analog meter shall indicate correct rudder angle in port direction.

(11) Press [AUTO].

(12) Turn on the remote controller.

The REM mode indication shall appear.

(13) Slowly turn the steering dial on the remote controller from hard over to hard over.

The rudder angle (analog) indication shall change accordingly.
The appropriate rudder direction indication shall light.

(14) Turn off the remote controller.

The AUTO mode shall be recalled.

(15) If a navaid is connected to the FAP-300;

Place the navaid in the fully operating condition and select a TO WAYPOINT. (Assign the present position to FROM WAYPOINT.)

Press [NAV].

The NAV mode indication shall appear. (The "N" sign should not be blinking.)

The course reading on the FAP-300 shall be the same as the one presented on the navaid.

(16) Turn off the FAP-300.

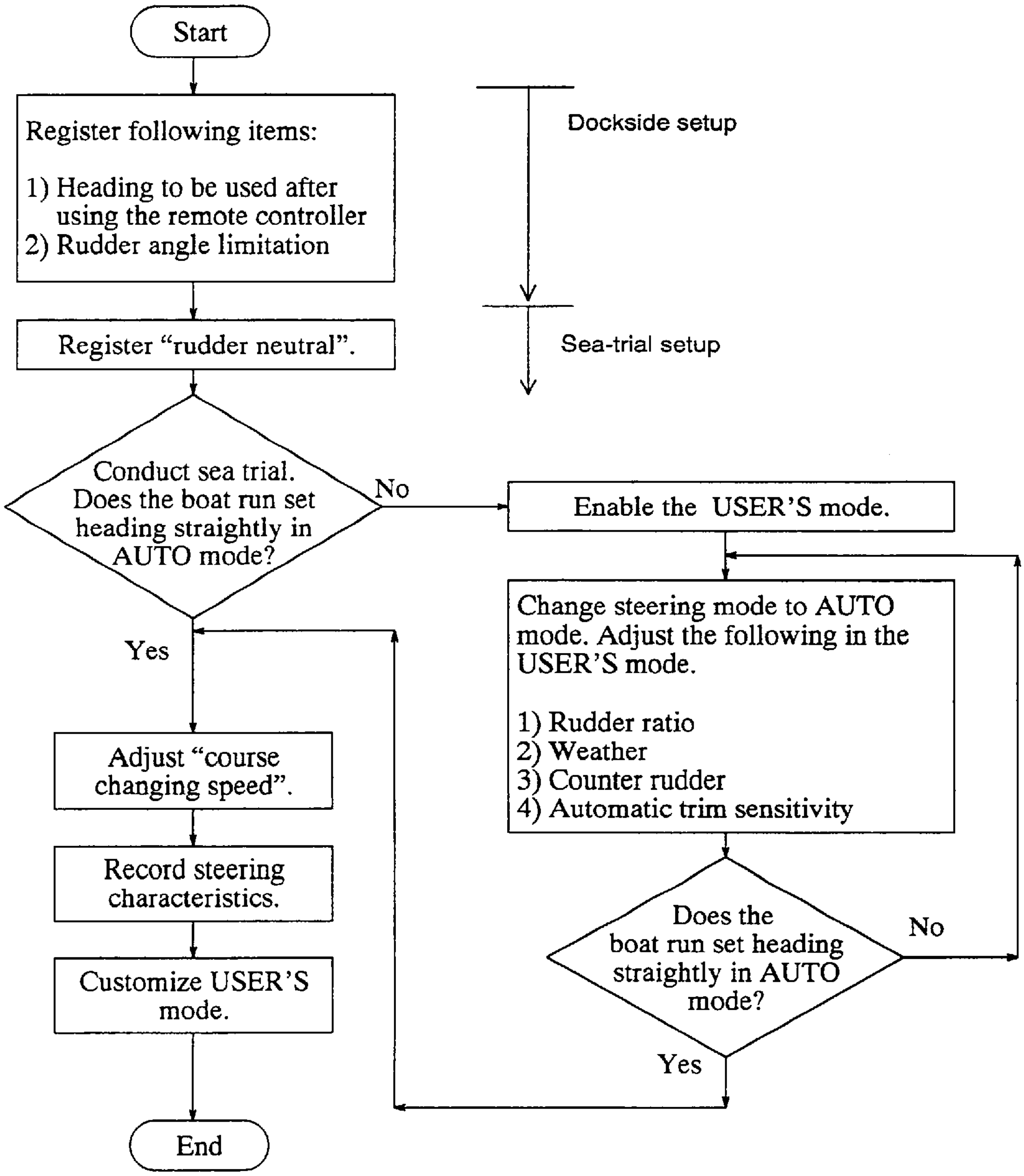
In addition to the above-mentioned function test, it is always a good idea to proceed out of the harbor and check FAP-300's performance in every mode.

2. Calibration of heading sensor

Calibrate the heading sensor referring to the manual for the heading sensor. Most of the weaving problems may be solved by compensating the heading sensor.

6. SETTING OF STEERING CHARACTERISTICS

This chapter shows you how to adjust the autopilot to match the steering characteristics of your boat. The procedure you will use to make the adjustment is shown by the flow chart which follows.



1. Setting modes

The FAP-300 has two modes for adjustment of steering characteristics and functions: the INITIAL SETTING mode and the USER'S mode. The INITIAL SETTING mode, consisting of nine items, mainly sets initial steering characteristics and functions. The USER'S mode contains five of the items which appear in the INITIAL SETTING mode. It is mostly used for adjustment of steering characteristics during the sea trial.

INITIAL SETTING mode

How to confirm the initial setting

1. Hold down [STBY] for more than 2 seconds to enable the INITIAL SETTING mode. The display for rudder ratio setting appears.

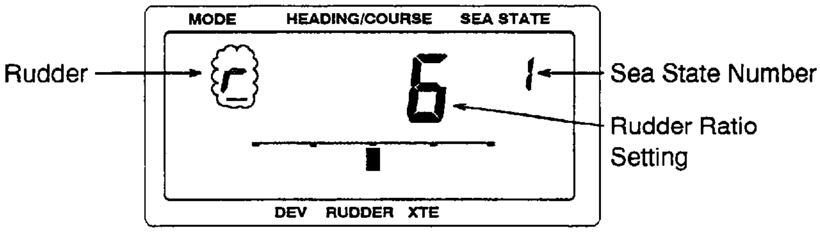


Fig. 6-1 Display for adjusting rudder ratio

2. Press [STBD] to select other item to confirm the setting.

   Each press of the key changes the display in the sequence shown in Fig. 6-2. You may also use the [PORT] key to select item, in which case the sequence is reversed.

3. Press [ALARM RESET] to escape.

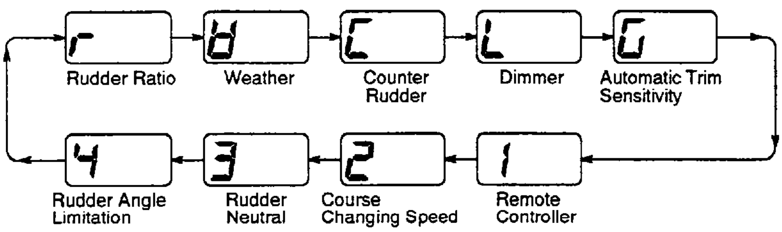


Fig. 6-2 Items in the initial setting mode

Description of initial settings

Item	Adjustment	Default		
		①	②	③
Rudder Ratio	Adjust the amount of rudder reaction versus course deviation.	5	6	7
Weather	Prevent frequent steering in bad weather.	2	4	6
Counter Rudder	Prevent excessive turning by inertia when changing course.	0	0	2
Dimmer	Adjust the illumination of keys and LCD.	1		
Automatic Trim Sensitivity	Adjust the sensitivity for monitoring the boat's trim.	6		
Remote Controller	Assign heading to be used after using the remote controller.	H		
Course Changing Speed	Adjust the course changing speed by the FAP-300.	3		
Rudder Neutral	Set the rudder neutral position.	000		
Rudder Angle Limitation (REM and DODGE modes)	Limit the maximum rudder angle, for safety in REM and DODGE modes.	8		

Sea State 1, 2, 3:

The combination of rudder ratio, weather and counter rudder is known as sea state. You can register three sets of sea states, and use the one which best matches current sea condition. More on this later.

USER'S mode

This mode enables adjustment of steering characteristics while operating the FAP-300 in the AUTO or NAV mode; namely, when cruising on the open sea.

Basic setting procedure

1. Press [SEA STATE] key to select sea state number.
2. Hold down the [SEA STATE] key more than 2 seconds to enable the USER'S mode.
3. Press the [SEA STATE] key to select item to adjust. Fig 6-3 shows the items available and the selection sequence when pressing the [SEA STATE] key.

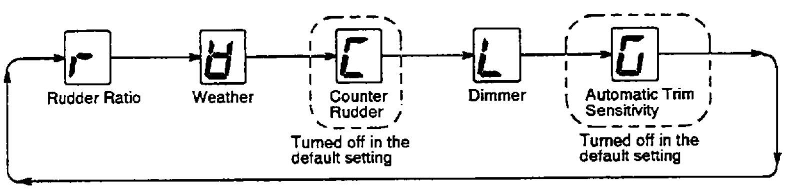


Fig. 6-3 Items in the user's mode

4. Operate the control dial to select setting.
5. Press [SEA STATE] to select another item, or press [ALARM RESET] to escape.

As shown in Fig. 6-3 the USER'S mode contains five items. In the default setting, counter rudder and automatic trim sensitivity are disabled since frequent adjustment of them is not necessary. You can enable them, or disable other items, as desired. More on this later.

2. Dockside setup

In this section, you will register the following:

1) Heading to be used after using the remote controller
2) Rudder angle limitation

Remote controller (Assign heading to be used after using the remote controller.)

Function of remote controller

The heading to be used after using the remote controller can be one of the following:

Setting	H	C
Function	The heading at the moment the remote controller is turned off.	The previous heading before using the remote controller.

Setting: H (Default)

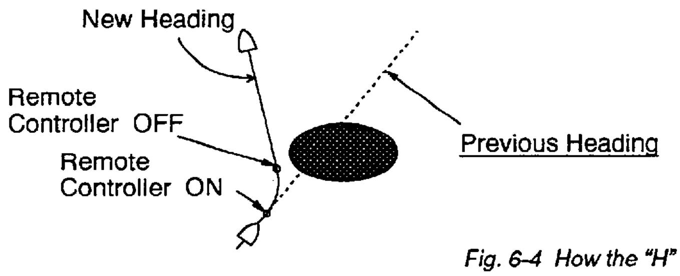


Fig. 6-4 How the "H" setting works

Setting: C

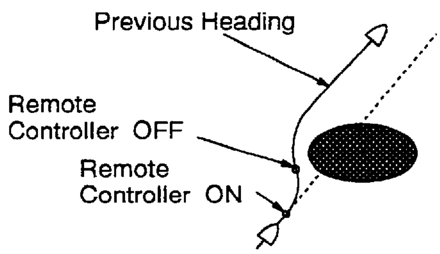


Fig. 6-5 How the "C" setting works

Procedure

1. Hold down STBY for more than 2 seconds to go into the INITIAL SETTING mode.

2. Press STBD several times to show the display which follows.

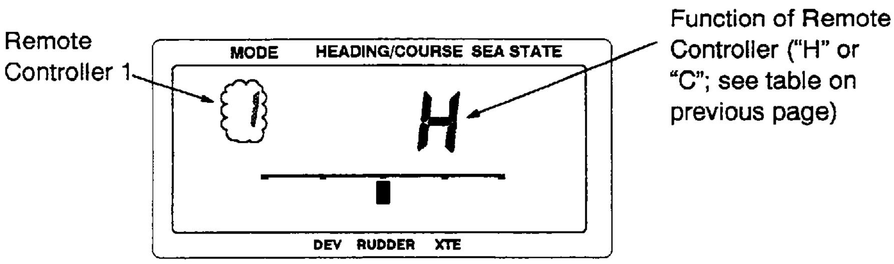


Fig. 6-6 Display for selecting the function of remote controller

3. Select the function with the control dial.

Rudder angle limitation (for the REM and DODGE modes)

About rudder angle limitation

In the REM or DODGE mode, usually a wide range of rudder angles are used, and therefore a larger number should be entered. However, the setting must not exceed the rudder limit angle which is inherent for your boat.

A number from "2" to "9" may be entered. The actual rudder angle limitation in degrees is obtained by multiplying the number by five;

Setting	2	3	4	5	6	7	8	9
Rudder Limit	± 10°	± 15°	± 20°	± 25°	± 30°	± 35°	± 40°	± 45°

Procedure

4. Press [STBD] several times to show the display which follows.

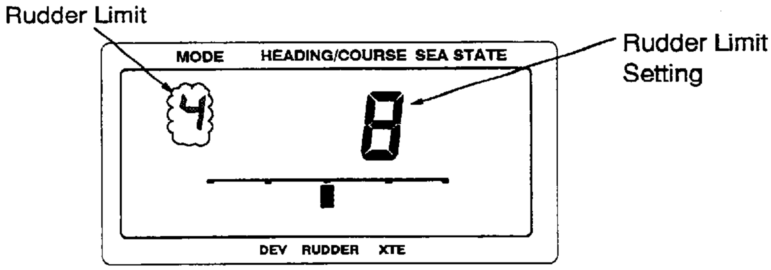


Fig. 6-7 Display for adjusting the rudder angle limitation in REM and DODGE modes

5. Change the value with the control dial.

6. Press [POWER OFF / ALARM RESET] to escape from the INITIAL SETTING mode.

NOTE

The rudder angle limitation for the AUTO and NAV modes may be preset by a jumper in the Processor Unit. Refer to "10. setting the rudder angle limitation for AUTO mode" in chapter 3.

Check after setting rudder angle limitation

1. Press [POWER ON / STBY] to go into the STBY mode.

2. Press [PORT] to steer the rudder to hard port.

   Confirm that the rudder driving indication on the front panel distinguishes. If it doesn't,

the rudder angle limitation exceeded the rudder limit angle which is inherent for the boat. Decrease the setting by one.

3. Press [STBD] to steer the rudder to hard starboard.

   Confirm that the rudder driving indication on the front panel distinguishes. If it doesn't, the rudder angle limitation exceeded the rudder limit angle which is inherent for the boat. Decrease the setting by one.

3. *Sea-trial setup*

Now it is time to check if your boat can run a set heading straightly with default steering characteristics, on the open sea. This trial should be conducted in calm water where there is no boat traffic of obstructions. You will do the following to determine suitability of default steering characteristics.

1) Register "rudder neutral".
2) Run your boat in the AUTO mode to see if it runs set heading straightly.

Registering rudder neutral

Procedure

1. Hold down [STBY] for more than 2 seconds to enable the INITIAL SETTING mode.

2. Press [STBD] several times to show the display which follows.

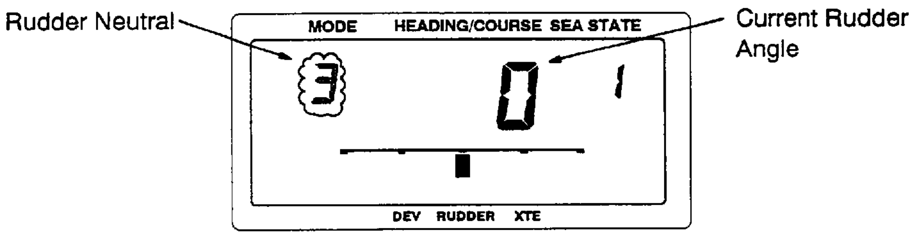


Fig. 6-8 Display for adjusting rudder neutral

3. Manually steer the boat straightly on steady course.

4. Press [SEA STATE] . The current rudder angle is registered as the rudder angle to run the boat straightly.

5. Press [ALARM RESET] to escape.

Checking the boat's track

Procedure

1. Turn on the power and press the [AUTO] key to go into the AUTO mode.

2. Observe your boat's track.

   If it runs the set heading straightly, the (default) steering characteristics match those of your boat's. No adjustment of steering characteristics is necessary. Proceed to "5. Adjusting course changing speed". If it weaves, go to the next section to modify steering characteristics.

4. Modifying the steering characteristics

This section shows you how to modify steering characteristics. You will do the following.

1) Enable the USER'S mode.
2) Adjust "rudder ratio", "weather", "counter rudder" and "automatic trim sensitivity" to run the boat straightly on a set heading.

Enabling the USER'S mode

Introduction

To adjust steering characteristics in the sea trial, enable the USER'S mode. The USER'S mode contains five items: rudder ratio, weather, counter rudder, dimmer and automatic trim sensitivity. In the default setting, counter rudder and automatic trim sensitivity are disabled. Turn them on here to enable adjustment of them.

Procedure

1. Hold down the [STBY] key until the display which follows appears.

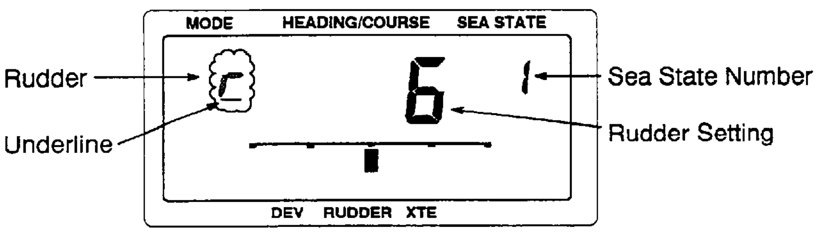


Fig. 6-9 Display for adjusting rudder ratio

2. Press [STBD] to select COUNTER RUDDER.

3. Press [SEA STATE] to set underline under C.

4. Enable AUTOMATIC TRIM SENSITIVITY as well.

5. Press [ALARM RESET] to escape.

Setting for SEA STATES ①, ② and ③

First set the steering characteristics (WEATHER, RUDDER RATIO and COUNTER RUDDER) for sea state ① . Then set them for SEA STATES ② and ③ . Note that you should select sea state number before going into the USER'S mode.

Assign any sea and vessel loading conditions to ② and ③ , such as "AUTO+Heavy Load" and "NAV". Enter settings referring to the table below. When sea/loading conditions change, use the appropriate SEA STATE (② or ③). Modify the settings to suit the actual situation.

The default settings for the steering characteristics are for the following sea states.

SEA STATE ① AUTO+Calm sea
SEA STATE ② AUTO+Normal sea
SEA STATE ③ AUTO+Rough sea

The settings for sea states ② and ③ may be changed, for example;

SEA STATE ① AUTO+Calm sea
SEA STATE ② AUTO+Rough sea
SEA STATE ③ AUTO+Full load

or

SEA STATE ① AUTO+Calm sea
SEA STATE ② AUTO+Full load
SEA STATE ③ NAV

Guidelines for setting sea states ② and ③

<table>
<tr><th>Item</th><th>If "AUTO+Rough sea" is assigned to ② or ③ ;</th><th>If "AUTO+Full load"is assigned to ② or ③ ;</th><th>If "NAV" is assigned to ② or ③ ;</th></tr>
<tr><td>WEATHER</td><td rowspan="2">Set the value 1 to 2 settings higher than ① .</td><td rowspan="3">Set the value 1 to 2 settings higher than ① .</td><td>Set the value 1 to 2 settings higher than ① .</td></tr>
<tr><td>RUDDER RATIO</td><td>Set the same value as ① .</td></tr>
<tr><td>COUNTER RUDDER</td><td>Set the same value as ① .</td><td>Set the same value as ① . (See note below.)</td></tr>
</table>

Note: In case of route navigation, non-zero setting should be used to prevent over-turning to return to course.

Rudder ratio (Adjust the amount of rudder reaction versus course deviation.)

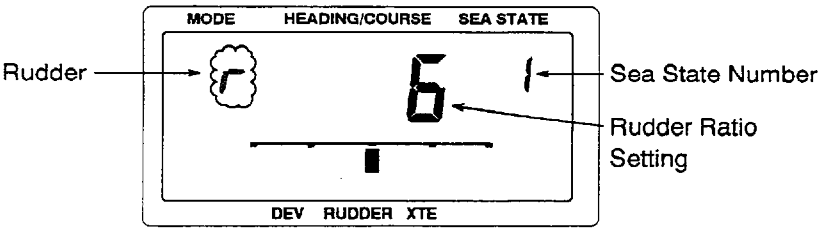


Fig. 6-10 Display for adjusting rudder ratio

About rudder ratio

When the boat's heading deviates from the set course, the FAP-300 adjusts the rudder to correct it. The rudder angle (number of degrees) which is steered against every degree of course deviation is known as the rudder ratio. Nine rudder ratio settings are available as tabulated below.

Setting	1	2	3	4	5	6	7	8	9
Rudder Ratio	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.5

The following illustrations show how many degrees the FAP-300 steers the rudder in order to nullify 10 degrees of course deviation with various settings of the rudder ratio:

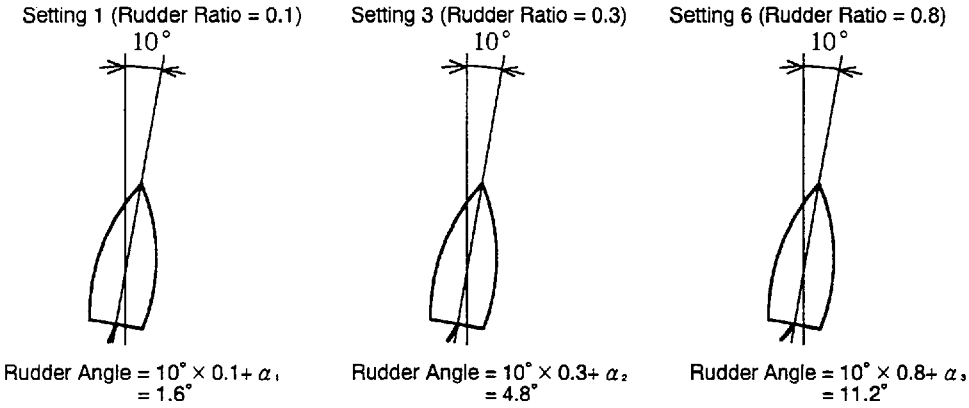


Fig. 6-11 Rudder angle and rudder ratio setting

Increase the setting until over-steering occurs, then reduce it by one. Fig. 6-12 provides general guidelines for setting rudder ratio. (Setting of "4" is commonly used.)

fast ←—— Boat's Speed ——→ slow

calm ←—— Sea Condition ——→ rough

light ←—— Load Condition ——→ heavy

low ←—— RUDDER RATIO ——→ high

Fig. 6-12 General guidelines for setting rudder ratio

Procedure

NOTE :

Sea state number should be selected (by the SEA STATE key) before going into the USER'S mode.

1. Hold down [SEA STATE] for 2 seconds if you are not already in the USER'S mode.
2. Change the setting with the control dial.
3. Press [SEA STATE] to proceed to the next step, or press [POWER OFF ALARM RESET] to escape.

Weather (Prevent frequent steering in bad weather.)

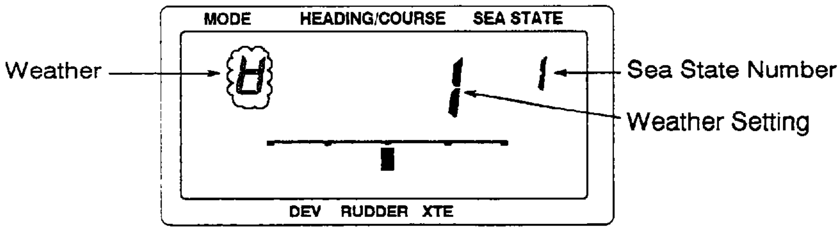


Fig. 6-13 Display for adjusting weather

About weather

When the sea is rough, the boat's heading wanders between port and starboard. If the rudder is driven very often to maintain the set course, the helm mechanism may wear out. To prevent this, the weather adjustment makes the FAP-300 insensitive to minute course deviations.

You may choose a setting (amount of heading change in degrees in which rudder is not driven) among the following ten. Until the course deviation exceeds the selected setting value, steering to correct the heading will not be initiated.

Setting	0	1	2	3	4	5	6	7	8	9
Value	0	± 0.5°	± 1.0°	± 1.5°	± 2.0°	± 2.5°	± 3.0°	± 3.5°	± 4.0°	± 4.5°

The following illustrations show boat's tracklines with weather settings 3 and 7. When 7 is set, for example, the rudder is not driven until the course deviation exceeds 3.5 degrees. Increasing the setting reduces chattering of the rudder, however the boat tends to zigzag.

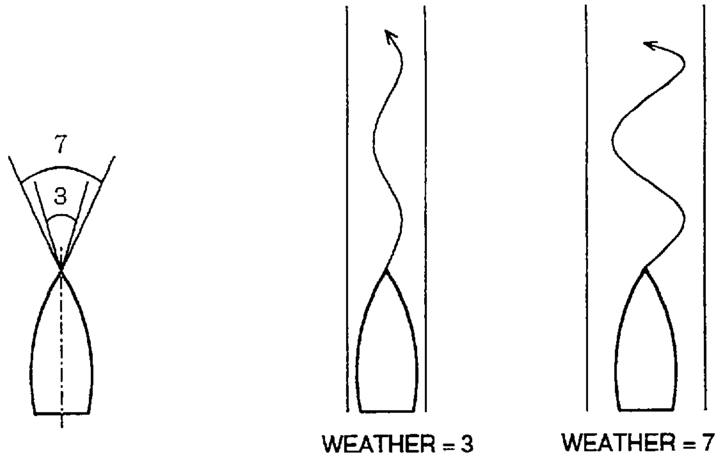


Fig. 6-14 Trackline and weather setting value

When favorable sea conditions exist, a setting of "1" or "2" is appropriate. For rough seas, a higher setting is required.

Procedure

1. Hold down [SEA STATE] for 2 seconds if you are not already in the USER'S mode.
2. Press [SEA STATE] to select "weather".
3. Change the setting with the course control dial.
4. Press [SEA STATE] to proceed to the next step, or press [POWER OFF ALARM RESET] to escape.

Counter rudder **(Prevent excessive turning by inertia when changing course.)**

Turned off in default setting.

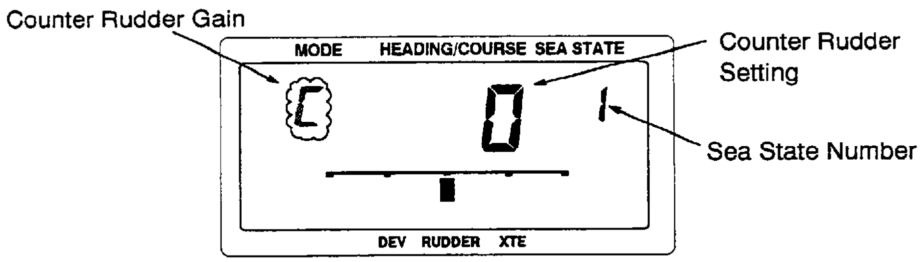


Fig. 6-15 Display for adjusting counter rudder gain

About counter rudder

If the boat is heavily loaded, the heading will turn excessively by inertia, passing the new course. Then, the FAP-300 will steer the rudder to the opposite side and the heading will turn in that direction excessively again... In an extreme case the heading oscillates several times until it finally settles in the new course. An adjustment known as "counter rudder" prevents this kind of oscillation.

Choose a counter rudder setting from "0" to "9"; the higher the setting, the more counter rudder is steered by the FAP-300. ("0" = no counter rudder)

Setting	0	1	2	3	4	5	6	7	8	9
Counter Rudder	None	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.5

Counter rudder is usually not required for small boats. When your boat zigzags a lot before settling in the new course, increase the setting.

Procedure

1. Hold down [SEA STATE] for 2 seconds if you are not already in the USER'S mode.
2. Press [SEA STATE] to select "counter rudder".
3. Change the setting with the course control dial.
4. Press [SEA STATE] to proceed to the next step, or press [POWER OFF/ALARM RESET] to escape.

Automatic trim sensitivity (Adjust the sensitivity for monitoring the boat's trim.)

Turned off in default setting.

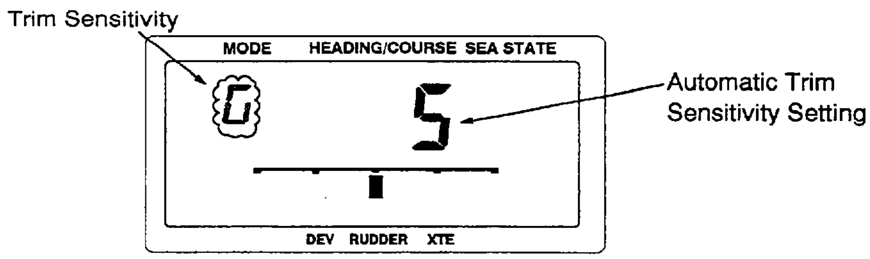


Fig. 6-16 Display for adjusting trim sensitivity

About auto trim sensitivity

The FAP-300 continually monitors the boat's trim in order to keep the compensation value optimum. You may enter a number from "1" to "9". A lower setting is common because boat's trim usually does not change quickly. A large number changes the trim compensation value more frequently. Too high a setting may result in the following problems.

1. Trim compensation is over-affected, resulting that a trim appears in both port and starboard directions alternately. The current trim can be shown on the LCD by enabling the "Performance Indication" mode. More on this later.

2. A boat usually yaws due to waves. If the trim setting is too high, the auto trim-compensation mechanism responds to the yawing, resulting in more serious oscillation of ship's heading.

Choice of setting

Run the boat with setting "0" (Auto trim sensitivity turned off), and measure the period of one cycle of yawing. If the period is two to three seconds, setting "5" will be appropriate. For longer periods, lower settings should be used. If the boat "goes" and "stops" frequently, or if the ship's speed is unstable, it might be better to disable the auto trim sensitivity function by using setting "0".

Procedure

1. Hold down [SEA STATE] for 2 seconds if you are not already in the USER'S mode.

2. Press [SEA STATE] to select "automatic trim sensitivity".

3. Change the setting with the control dial.

4. Press [POWER OFF ALARM RESET] to escape.

Performance indication

Introduction

The display can show autopilot performance-related indications. You may want to display them when your boat does not run straightly in the AUTO mode, to determine what item requires adjustment. You can display the following:

- Rudder angle
- Automatic trim compensation
- Rudder deadband

Procedure

1. Turn off the power. Turn on the # 3 segment of the DIP switch S1 on the LCD Board in the Control Unit.

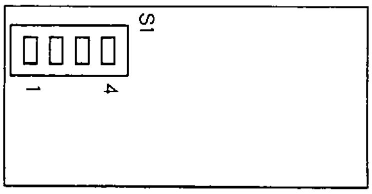


Fig. 6-17 Location of the DIP switch on LCD board

2. Turn on the power.

3. Press the SEA STATE key for about two seconds. The following display appears.

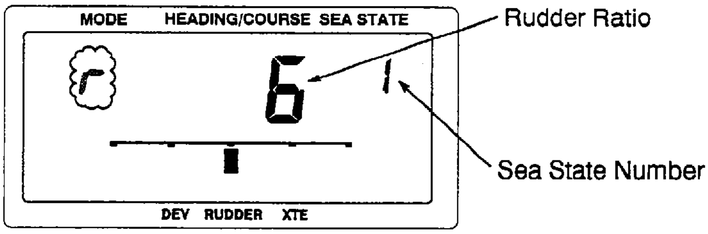


Fig. 6-18 Rudder ratio and sea state number display

4. Press SEA STATE key several times to display current rudder angle.

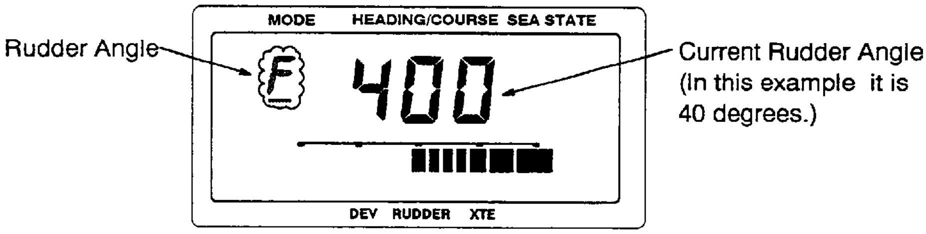


Fig. 6-19 Rudder angle display

5. Press SEA STATE key once to display automatic trim compensation value.

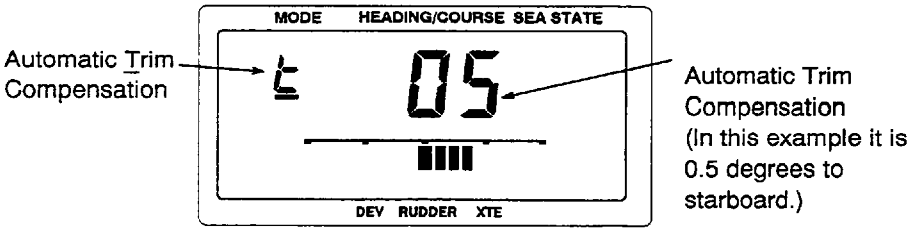


Fig. 6-20 Automatic trim compensation display

The maximum value for the automatic trim compensation is 5 degrees. When the boat does not run straightly with the value "5", register the rudder neutral again or activate the "Net towing AUTO". The maximum trim is 10 degrees less than the rudder angle limitation for REM and DODGE modes.

6. Press SEA STATE key once to display the rudder deadband.

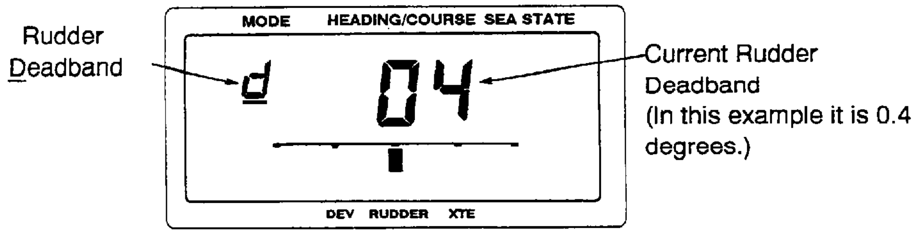


Fig. 6-21 Rudder deadband display

The value should be smaller than 1.5 degrees. The rudder will hunt when the value is larger than 1.5 degrees. Decrease the oil flow to slow the rudder speed to stop the hunting. The FAP-300 can control the hunting when the value is smaller than 1.5 degrees.

7. After observing the indications, turn off the power and then turn off the # 3 segment of the DIP switch S1 on the LCD Board in the Control Unit.

5. Adjusting course changing speed

Once your boat is running straightly in the AUTO mode, adjust the course changing speed.

About course changing speed

The course changing speed is the speed in degrees per second in which the FAP-300 will take to change course.

Danger !

Too high a setting will turn the boat sharply at a course change.

Checking the course changing speed

1. Run the boat straightly in the AUTO mode.
2. Change the course 90 degrees by holding down [STBD] or [PORT] .
3. Release the key.
   Observe the course changing speed while the boat returns to the previous course.

You may enter a number from "1" to "7", which corresponds to the course changing speed of 1 degree/sec to 9 degrees/sec, respectively.

Setting	1	2	3	4	5	6	7
Course Changing Speed (degree/second)	1	2	3	4	5	6	7

A setting of "3" or so is commonly used for a 10 to 15-knot cruising speed. When you feel

the course changing speed is too fast, decrease the setting.

Procedure

1. Hold down [STBY] for more than 2 seconds to go into the INITIAL SETTING mode.
2. Press [STBD] several times to show the display which follows.

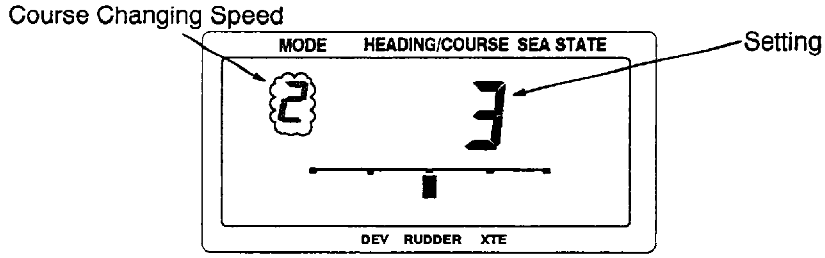


Fig. 6-22 Display for adjusting course changing speed

3. Change the value with the control dial.
4. Press [ALARM RESET] to escape.

6. Record of steering characteristics

Whenever the steering characteristics are entered or changed, you should record them in the following table. In the event of loss of the settings, reenter them referring to this table.

Item	Default			Settings		
	①	②	③	①	②	③
Rudder Ratio	5	6	7			
Weather	2	4	6			
Counter Rudder	0	0	2			
Dimmer	1					
Automatic Trim Sensitivity	6					
Remote Controller	H					
Course Changing Speed	3					
Rudder Neutral	000					
Rudder Angle Limitation (REM and DODGE modes)	8					

7. Customizing the USER'S mode

Introduction

The USER's mode contains five items which the user may adjust when necessary: rudder ratio, weather, counter rudder, dimmer and automatic trim sensitivity. In the default setting counter rudder and automatic trim sensitivity are turned off. You may turn them on, or disable other items, as desired.

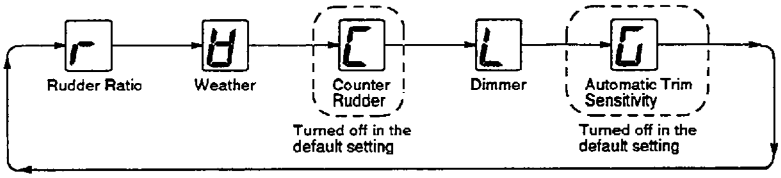


Fig. 6-23 Items in the user's mode

Procedure

1. Hold down [STBY] key for more 2 seconds.
2. Press [STBD] to select item to turn on or off.
3. Press [SEA STATE] to turn item on or off; underline appears beneath item when it is enabled.

NOTE

The underline does not appear beneath the following items to show they are not available for adjustment in the "USER'S mode".

Remote controller
Course changing speed
Rudder neutral
Rudder angle limitation

4. Press [ALARM RESET] to escape.

7. MAINTENANCE

1. Self-test

Introduction

This unit has a self-test facility which checks for proper operation.

Procedure

1. While holding down the [SEA STATE] key, turn on the power.
2. Press the [STBD] key to select test. Each press changes the test, as well as the display indication, in the sequence shown in Fig. 7-1. Note that you can also select a test by the [PORT] key, in which case the sequence is reversed.
3. Selected test is executed and the results appear on the display.
4. Press [STBD] to select another test, or press [ALARM RESET] to escape.

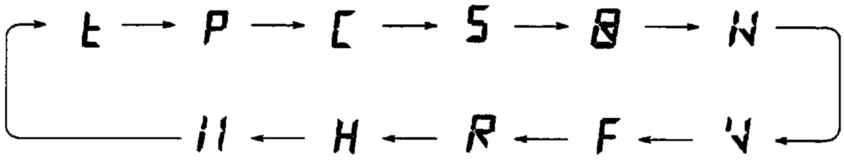


Fig. 7-1 Sequence of self-test

t	ROM and RAM test	V	Input voltage check
P	Program version number	F	Rudder reference feedback signal test
C	Memory all clear	R	Remote controller function test
S	DIP switch setting	H	Rudder speed test
8	LCD segment test	11	Rudder play test
N	Navigation signal test		

ROM and RAM test

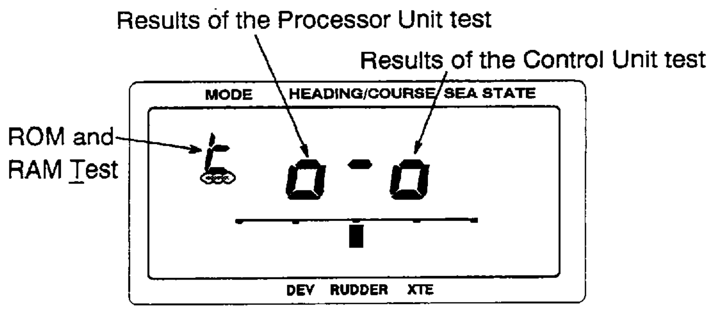


Fig. 7-2 Sample ROM and RAM test result

- 0 : Normal
- 1 : ROM defective
- 2 : RAM defective
- 3 : Both ROM and RAM defective
- 4 : EEPROM defective

Program version number

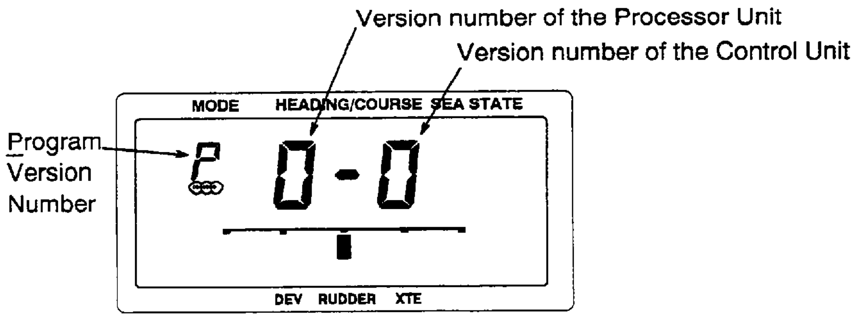


Fig. 7-3 Program version number display

Clearing the memory **(Clear when data in EEPROM is lost.)**

You can clear all the internal settings memorized in the EEPROM.
Press [SEA STATE] to clear the memory.

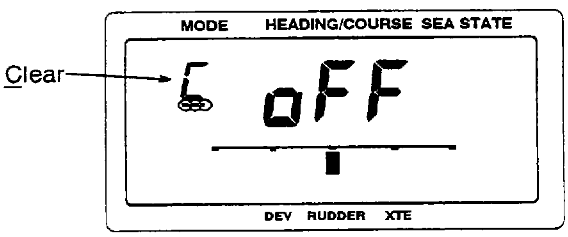


Fig. 7-4 Indication before clearing the memory

- The display shows ON while the memory is being cleared.

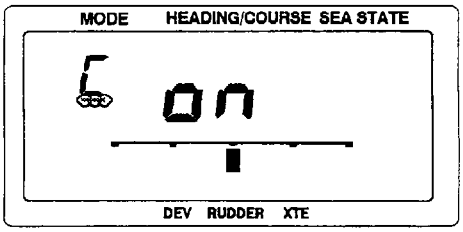


Fig. 7-5 Indication while clearing the memory

- When the memory is cleared the display looks like Fig. 7-6.

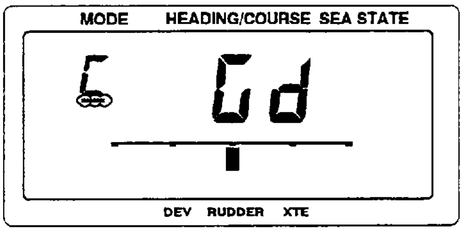


Fig. 7-6 Indication after clearing the memory

- If the memory could not be cleared the display looks like Fig. 7-7. In this case the EEPROM may be defective.

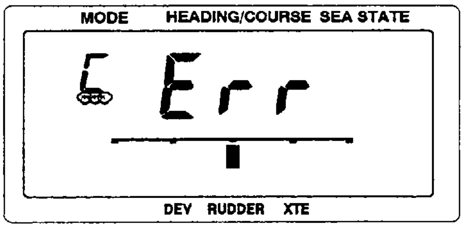


Fig. 7-7 Indication when memory could not be cleared

DIP switch settings

The results are shown in hexadecimal notation. "OFF" is "0" and "ON" is "1".

Example

Segment 5, 6, 7 and 8 are OFF, OFF, ON and ON, respectively.
This is 0, 0, 1, 1 so the presentation will be "C".

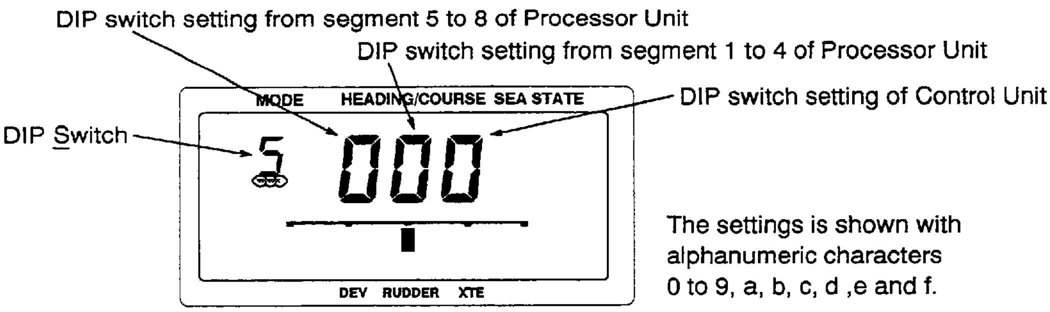


Fig. 7-8 Sample DIP switch setting for each unit

LCD segment test

Press SEA STATE to start the test. The LCD segments turn on one by one in following sequence:

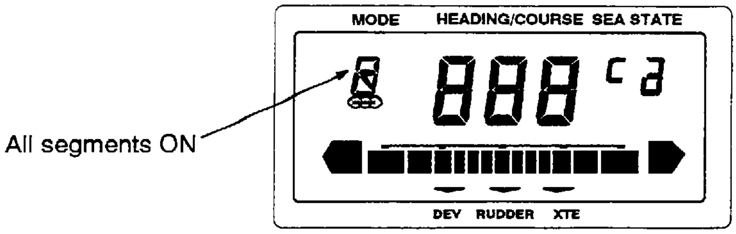


Fig. 7-9 First presentation in LCD segment test

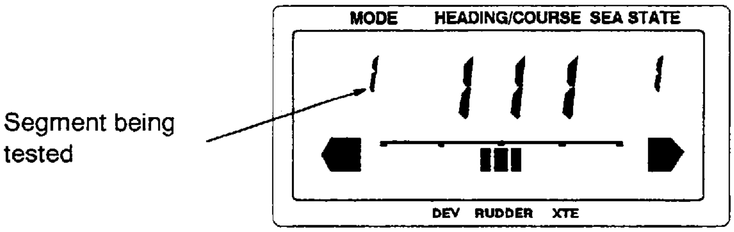


Fig. 7-10 Second presentation in LCD segment test

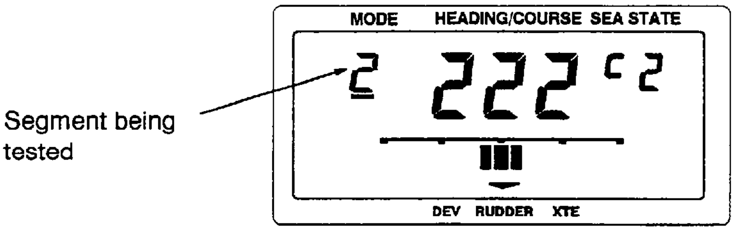


Fig. 7-11 Third presentation in LCD segment test

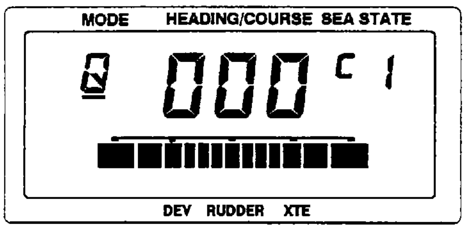


Fig. 7-12 Final presentation in LCD segment test

Navigation signal test

Navigation signals such as waypoint data, cross-track error data, speed data and arrival data are required to control the FAP-300 in the NAV mode. You can confirm that they are being input.

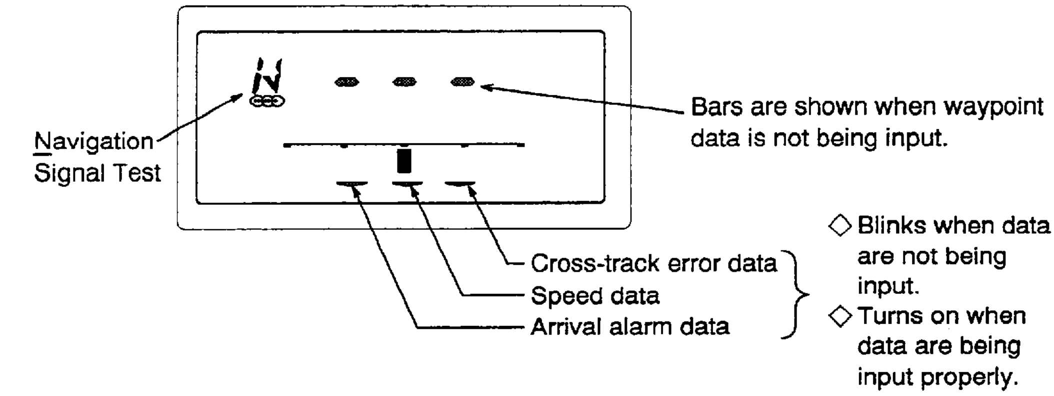


Fig. 7-13 Indication when no navigation data are input

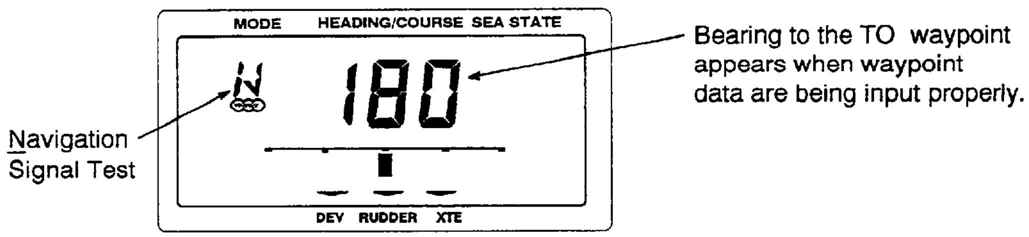


Fig. 7-14 Indication when all navigation data are being input

Input voltage presentation

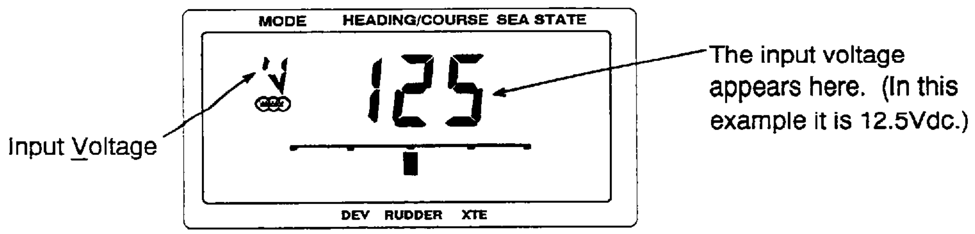


Fig. 7-15 Input voltage display

Rudder reference unit feedback signal test

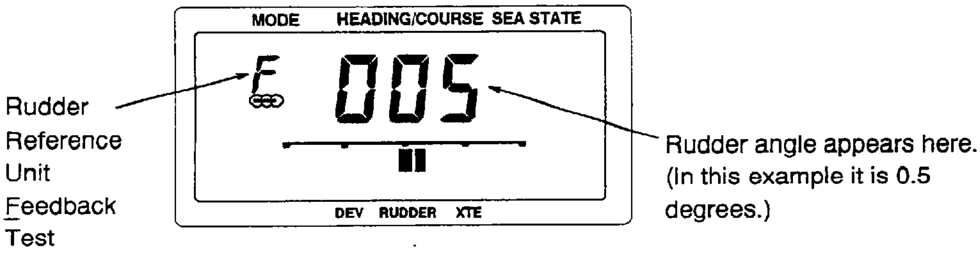


Fig. 7-16 Indication of rudder reference unit signal

Remote controller function test

The LCD shows the data sent from the FAP-5551 (Dial-type remote controller). Other types of remote controllers cannot be tested.

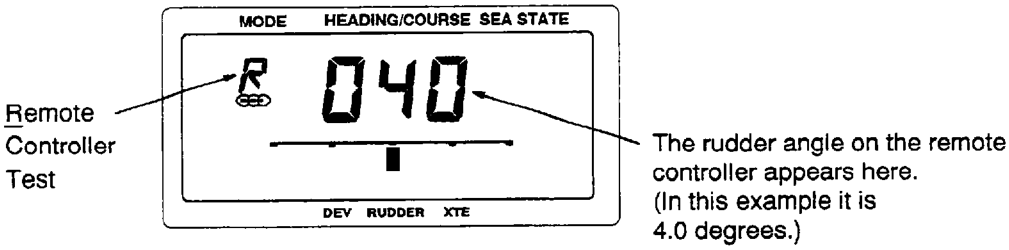


Fig. 7-17 Indication for FU (Follow-Up)- type remote controller

The LCD shows three dashes when the remote controller is turned off.

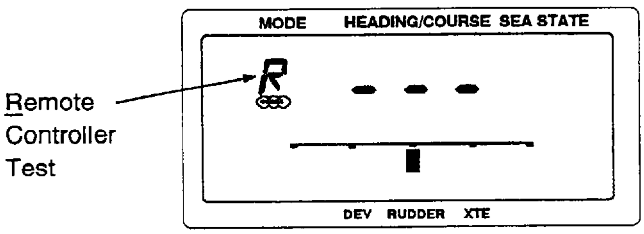


Fig. 7-18 Indication when the remote controller is turned off

Rudder speed test

Set the rudder angle limitation before executing the test.

— **WARNING** —

This test drives the rudder from hard port to hard starboard to calculate actual rudder speed. Therefore, do not execute the test when the boat is running.

Press SEA STATE to start the test.

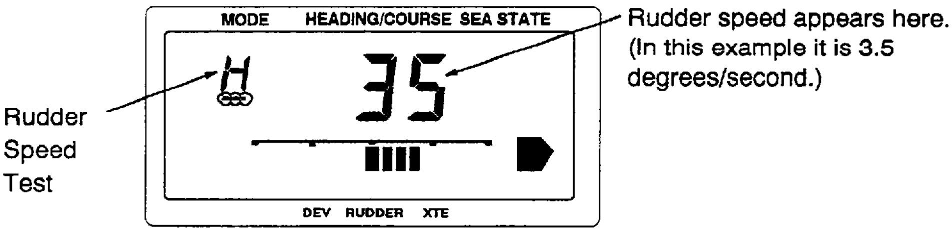


Fig. 7-19 Indication of rudder speed

While calculating rudder speed, the display looks like Fig. 7-20.

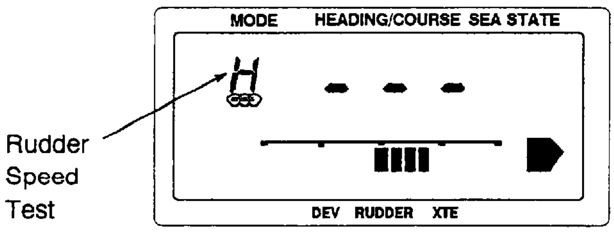


Fig. 7-20 Indication while calculating rudder speed

Rudder play test

The CPU calculates the rudder play while testing the rudder speed. Execute the rudder speed test and then the rudder play test.

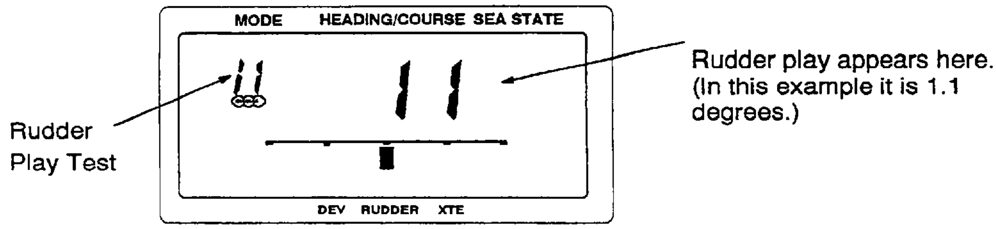


Fig. 7-21 Indication of rudder play

While calculating rudder play, the display looks like Fig. 7-22.

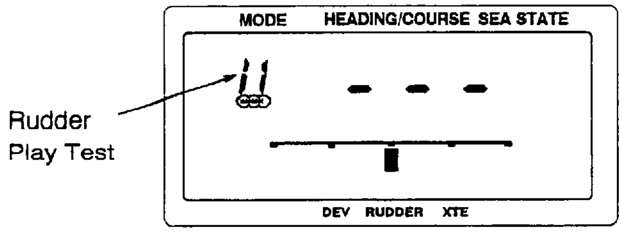


Fig. 7-22 Indication while calculating rudder play

2. Checking LED status

The LEDs in the Processor Unit light or flicker according to autopilot operation.

LED Number	Status
CR12	Flickers every 0.5 seconds.
CR23	Lights while turning the rudder left.
CR24	Lights while turning the rudder right.
CR26	Lights while driving a DC motor pump.

Equipment List

Standard Supply

Name	Type	Qty	Wt. (kg)	Remarks
Control Unit	FAP-3001	1	0.6	
Processor Unit	FAP-3002	1	0.8	
Rudder Reference Unit	FAP-6110	1	0.2	
Accessories	FP64-00800	1 set		
Spare Parts	SP64-01000	1 set		
Installation Material	CP64-01500	1 set		

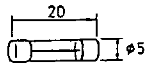
Optional Supply

Name	Type	Code No.	Qty	Remarks
FU (Follow-up) Remote Controller	FAP-5551E	000-090-224		Dial type
NFU (Non-follow-up) Remote Controller	FAP-6211E	000-090-235		Button type
NFU Remote Controller	FAP-6221E	000-090-239		Lever type
Dodge Remote Controller	FAP-6231E	000-090-251		Dodge type
Distributor	FAP-6800	000-090-242		
Rudder Telltale	FAP-6501E	000-090-240		
Valve Unit (w/8m cable and crimp-on lugs)	SPF-1SVF-12/E	000-090-130		12Vdc
	SPF-1SVF-24/E	000-090-131		24Vdc
Flush Mounting Materials	OP20-18	000-040-721		F type for FAP-3001
	OP20-17	000-040-720		S type for FAP-3001
Hanger	OP64-2	009-004-030		for FAP-5551
Flush Mounting Materials	OP64-4	009-005-790		F type for FAP-6221/6501
	OP64-5	009-005-800		S type for FAP-6501
Signal Cables	MJ-A6SPF 0007-100	000-125-237		To connect Navaid or rudder telltale unit
	MJ-A6SPF 0008-200	000-126-661		20m cable for rudder reference unit
	MJ-A10SPF 0001-120	000-126-660		12m cable for remote controller
	MJ-A10SPF 0002-100	000-126-659		10m cable for control unit
	20S0093	000-117-603		To connect AD-100

FURUNO

CODE No.	000-090-248	BOX No. P
TYPE	SP64-01000	

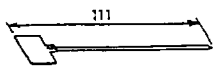
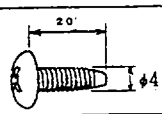
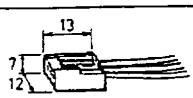
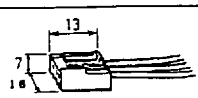
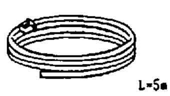
SHIP No.	SPARE PARTS LIST FOR	USE	SETS PER VESSEL
	FAP-300 オートパイロット AUTO PILOT		

ITEM No.	NAME OF PART	OUTLINE	DWG. No. OR TYPE No.	QUANTITY WORKING PER SET	QUANTITY WORKING PER VES.	SPARE	REMARKS/CODE No.
1	ミゼットヒューズ FUSE		FGMB 5A AC125V			3	000-112-785

FURUNO

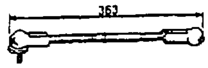
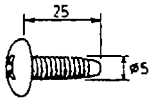
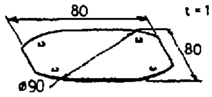
CODE No.	000-090-254	64AQ-X-9401
TYPE	CP64-01500	

工事材料表 INSTALLATION MATERIALS	FAP-300	オートパイロット AUTO PILOT	

番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｹｰﾌﾞﾙﾊﾞﾝﾄﾞ CABLE CLAMP		PLF1M-M CODE NO. 000-116-921	5	
2	+ﾄﾗｽﾀｯﾋﾟﾝｸﾞﾈｼﾞ +TAPPING SCREW		M4 × 20 SUS304 CODE NO. 000-805-687	8	
3	ﾐｶﾞｷ平座金 FLAT WASHER		M4 SUS304 CODE NO. 000-864-126	8	
4	VHコネクタ CONNECTOR		64-103(3P) CODE NO. 009-013-100	1	
5	VHコネクタ CONNECTOR		64-104(4P) CODE NO. 009-013-200	1	
6	電源ケーブル組品 POWER CABLE ASSEMBLY		P64-1-5 CODE NO. 009-012-530	1	
7	ケーブル組品 CABLE ASSY.		MJ-A10SPF0002-050 CODE NO. 000-131-411	1	

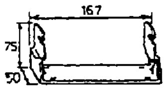
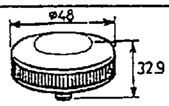
FURUNO

CODE No.	000-012-450	64AQ-X-9402-1
TYPE	CP64-01700	

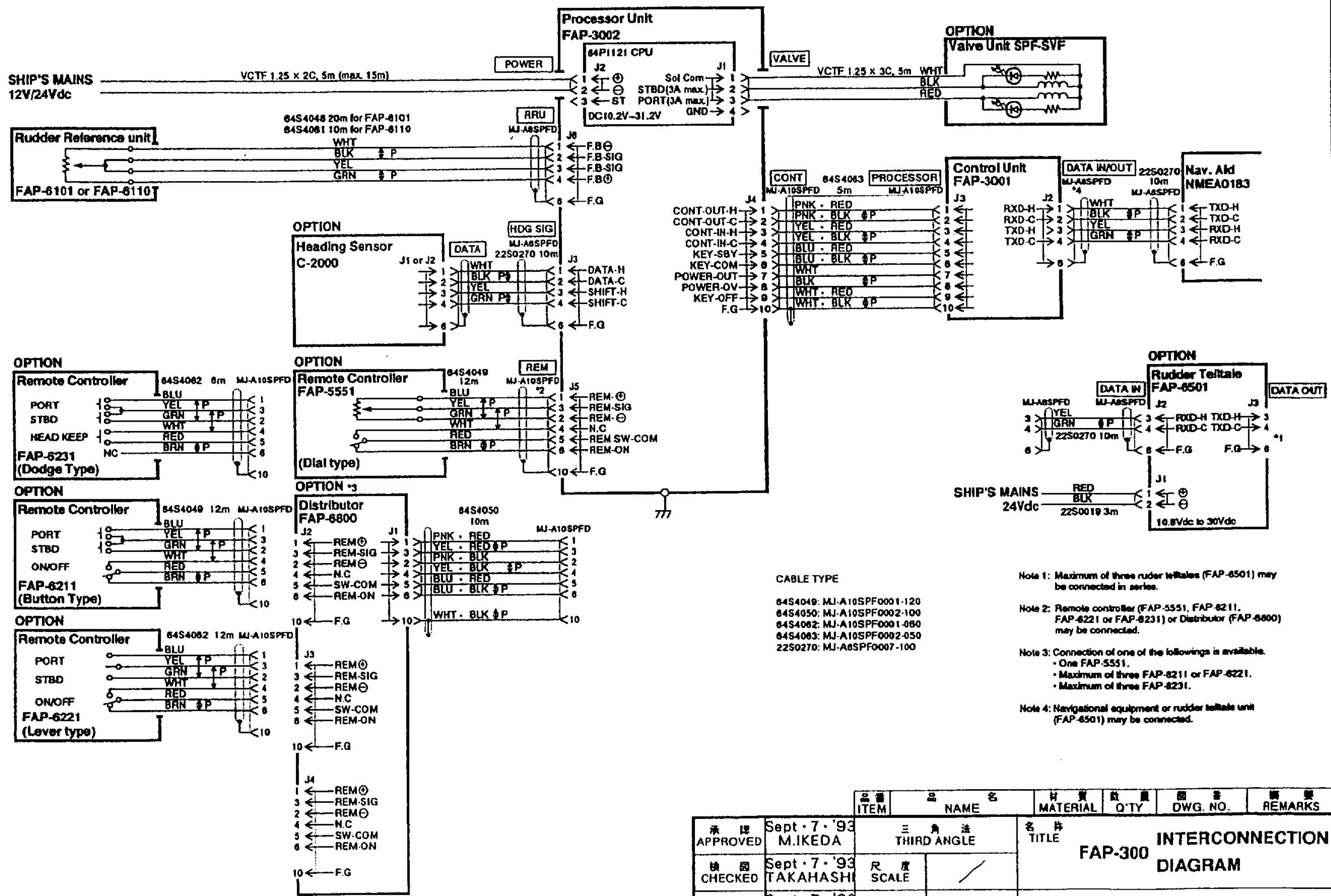
工事材料表 INSTALLATION MATERIALS		FAP-6110	追従発信器 RUDDER REFERRENCE UNIT		
番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	連結棒組立品 CONNECTING ROD ASSY.		CP64-01710 CODE No. 009-013-210	1	
2	+ﾄﾗｽﾀｯﾋﾟﾝｸﾞﾈｼﾞ +TAPPING SCREW		M4 × 20 SUS304 CODE No. 000-805-687	4	
3	ﾐｶﾞｷ平座金 FLAT WASHER		M4 SUS304 CODE No. 000-864-126	4	
4	ｶﾞｽｹｯﾄ(3) GASKET		64-019-5009-0 CODE No. 100-205-550	1	

FURUNO

CODE No.	000-090-249	64AQ-X-9501
TYPE	FP64-00800	

付属品表 ACCESSORIES		FAP-300	オートパイロット AUTO PILOT		
番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ハンガー HANGER		20-007-2301-1 CODE No. 100-183-181	1	
2	ﾉﾌﾞﾎﾞﾙﾄ組品 KNOB BOLT ASSY.		20-007-2302-1 CODE No. 100-173-271	2	

FURUNO



CABLE TYPE

64S4049: MJ-A10SPF0001-120
64S4050: MJ-A10SPF0002-100
64S4062: MJ-A10SPF0001-080
64S4063: MJ-A10SPF0002-050
22S0270: MJ-A6SPF0007-100

Note 1: Maximum of three ruder telltales (FAP-6501) may be connected in series.

Note 2: Remote controller (FAP-5551, FAP-6211, FAP-6221 or FAP-6231) or Distributor (FAP-6800) may be connected.

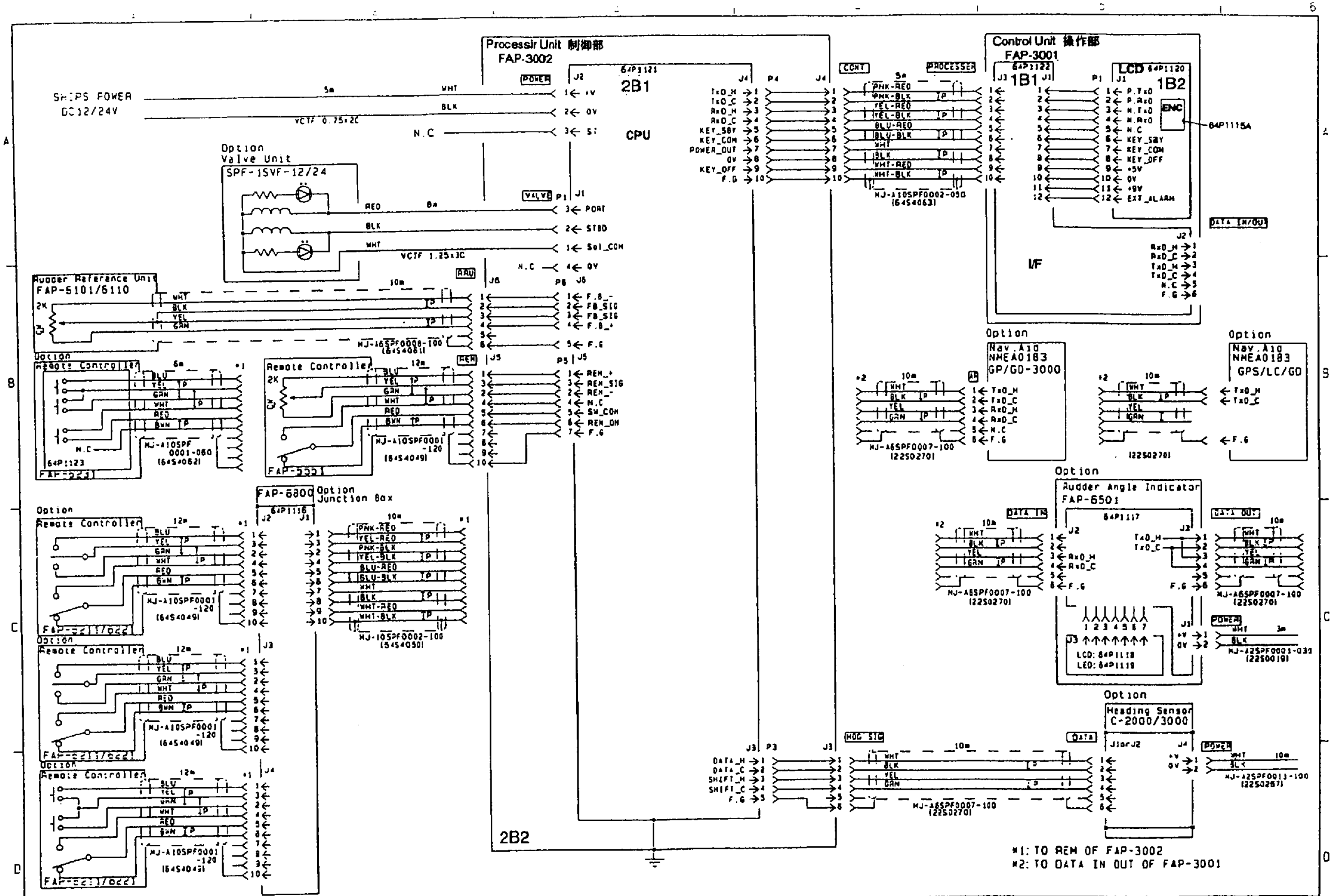
Note 3: Connection of one of the followings is available.
- One FAP-5551.
- Maximum of three FAP-6211 or FAP-6221.
- Maximum of three FAP-6231.

Note 4: Navigational equipment or rudder telltale unit (FAP-6501) may be connected.

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	Sept · 7 · '93 M.IKEDA	三角法 THIRD ANGLE	名称 TITLE FAP-300 INTERCONNECTION DIAGRAM
検図 CHECKED	Sept · 7 · '93 TAKAHASHI	尺度 SCALE /	
製図 DRAWN	Sept · 7 · '93 S.Nishi	重量 WEIGHT kg	図番 DWG.NO E7237-C01-D

FURUNO ELECTRIC CO., LTD.



REMARKS

DRAWN E.MIYOSHI

SCALE / MASS kg

APPLICABLE TO: (MODEL)

BLOCK NO.

TYPE FAP-300

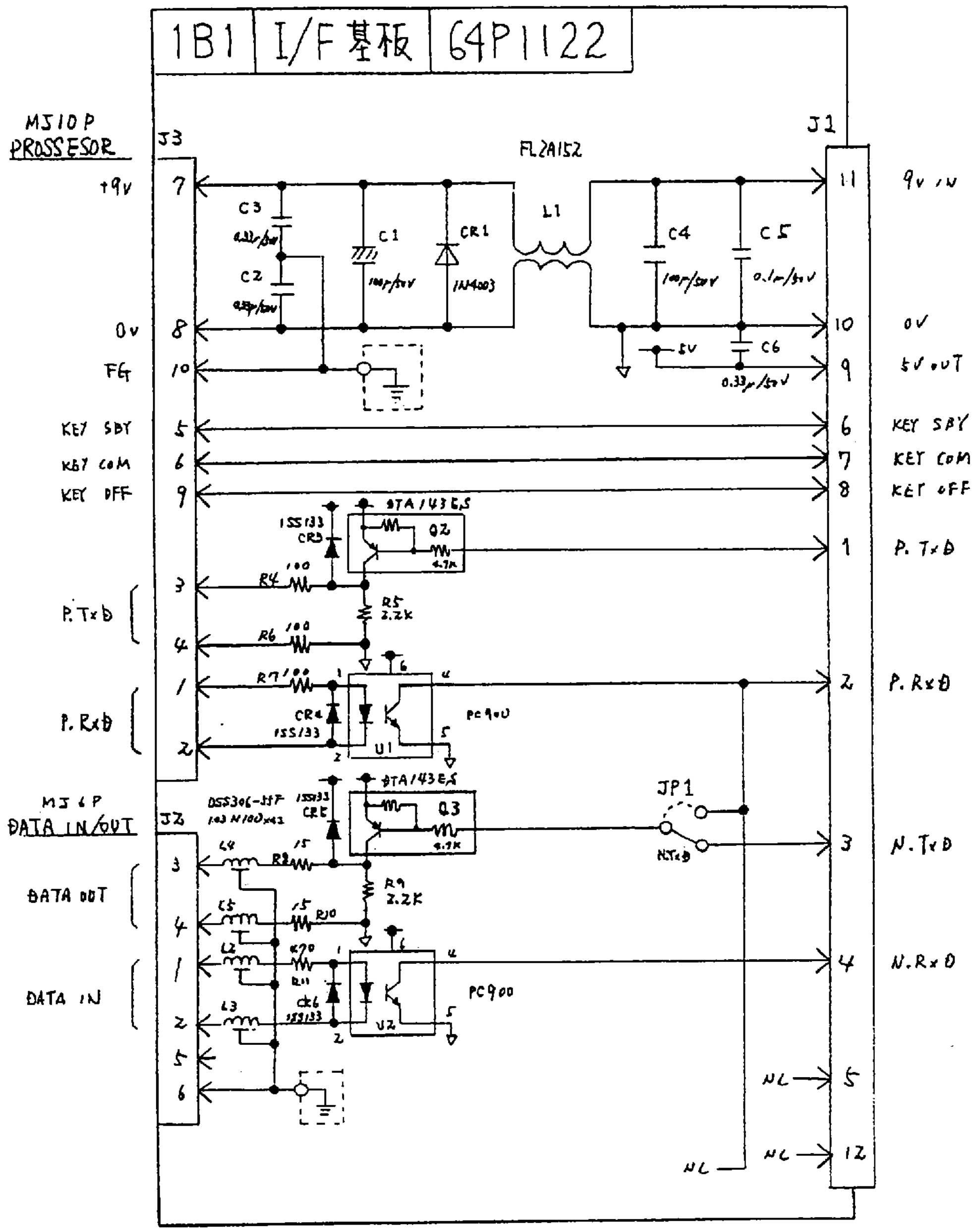
名称 オートパイロット

NAME AUTOPILOT

DWG NO. C7237-K04- A

REV NO | MARK | DATE | REMARKS

FURUNO ELECTRIC CO LTD

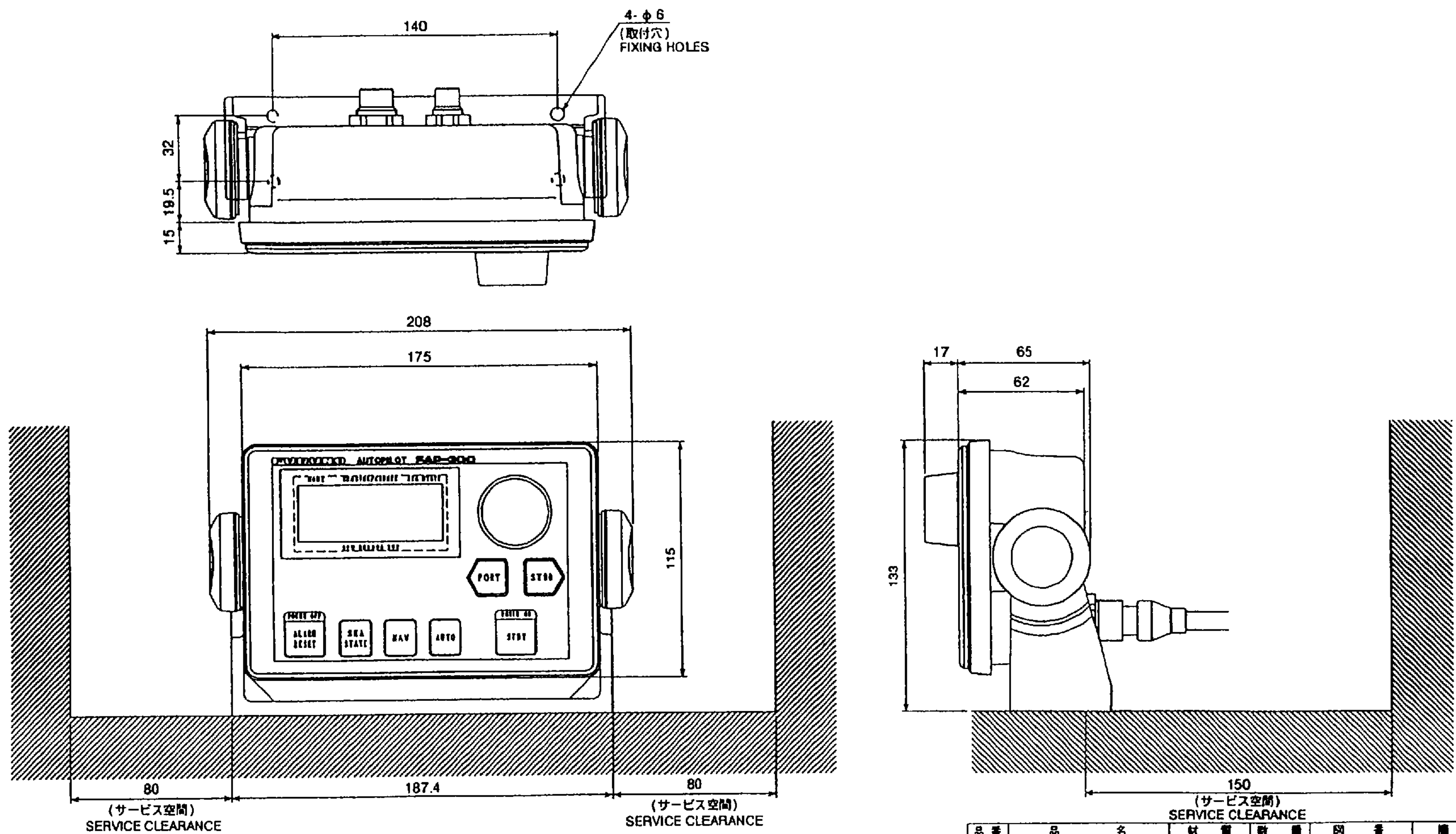


FAP-3001

承認 APPROVED	Sept・7・'93 M. Ikeda	三角法 THIRD ANGLE		名称 TITLE 64P1122	I/F基板 I/F board
検図 CHECKED	Sept・7・'93 TAKAHASHI	尺度 SCALE	/		
製図 DRAWN	Sept・7・'93 S. Nishi	重量 WEIGHT	kg	図番 DWG.NO	C7237-K03-B

FURUNO ELECTRIC CO., LTD.

FURUNO

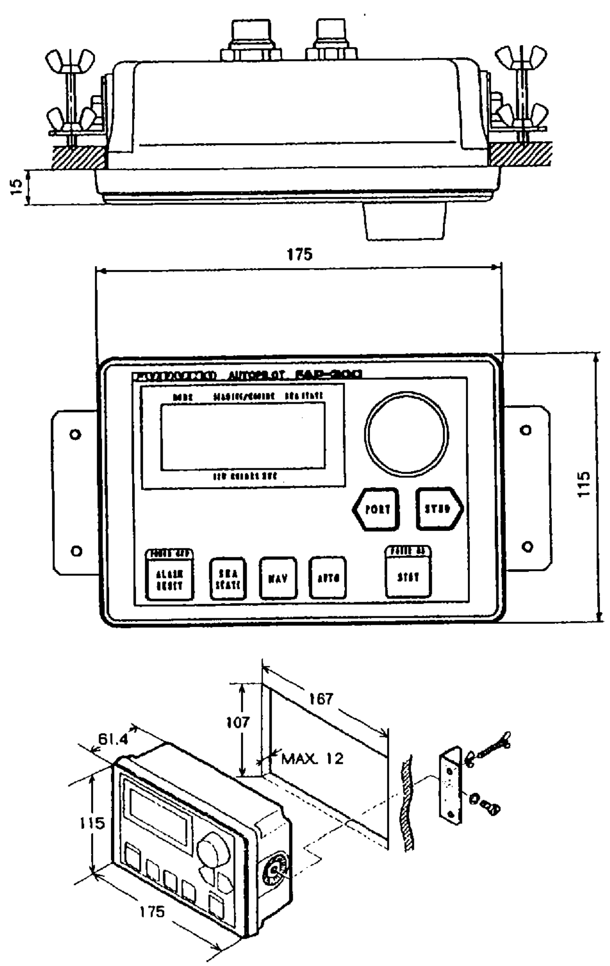


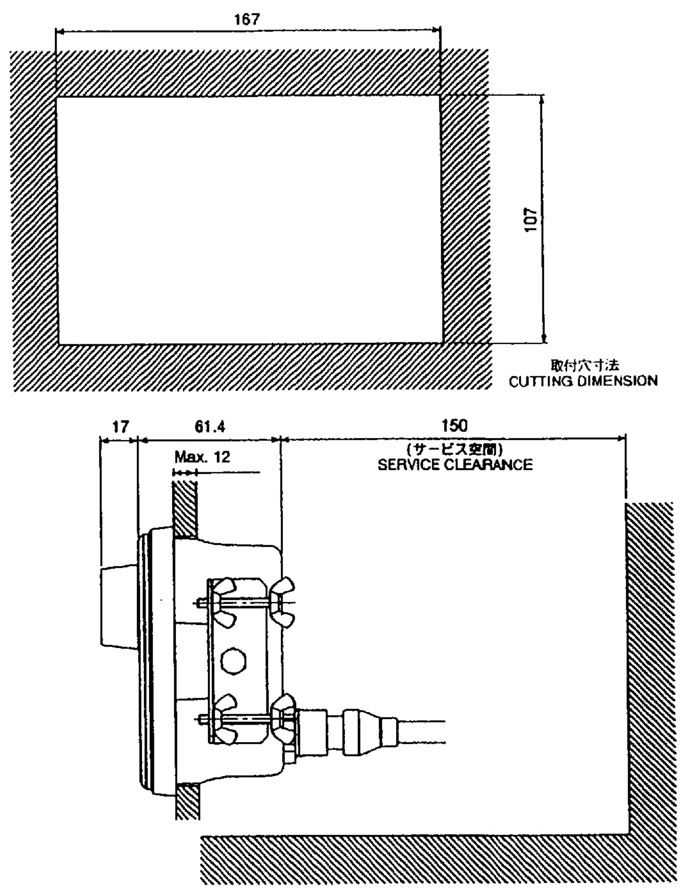
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	備要 REMARKS

承認 APPROVED	SEP・6・'93 M. IKEDA	三角法 THIRD ANGLE	名称 TITLE FAP-3001	操作部(ハンガー装備) CONTROL UNIT (HANGER MOUNT)
検図 CHECKED	SEP・3・'93 TAKAHASHI	尺度 SCALE		
製図 DRAWN	SEP・2・'93 S. NISHI	重量 WEIGHT	0.6 kg	図番 DWG.NO C7237-G01-A

FAP-300

FURUNO ELECTRIC CO., LTD.





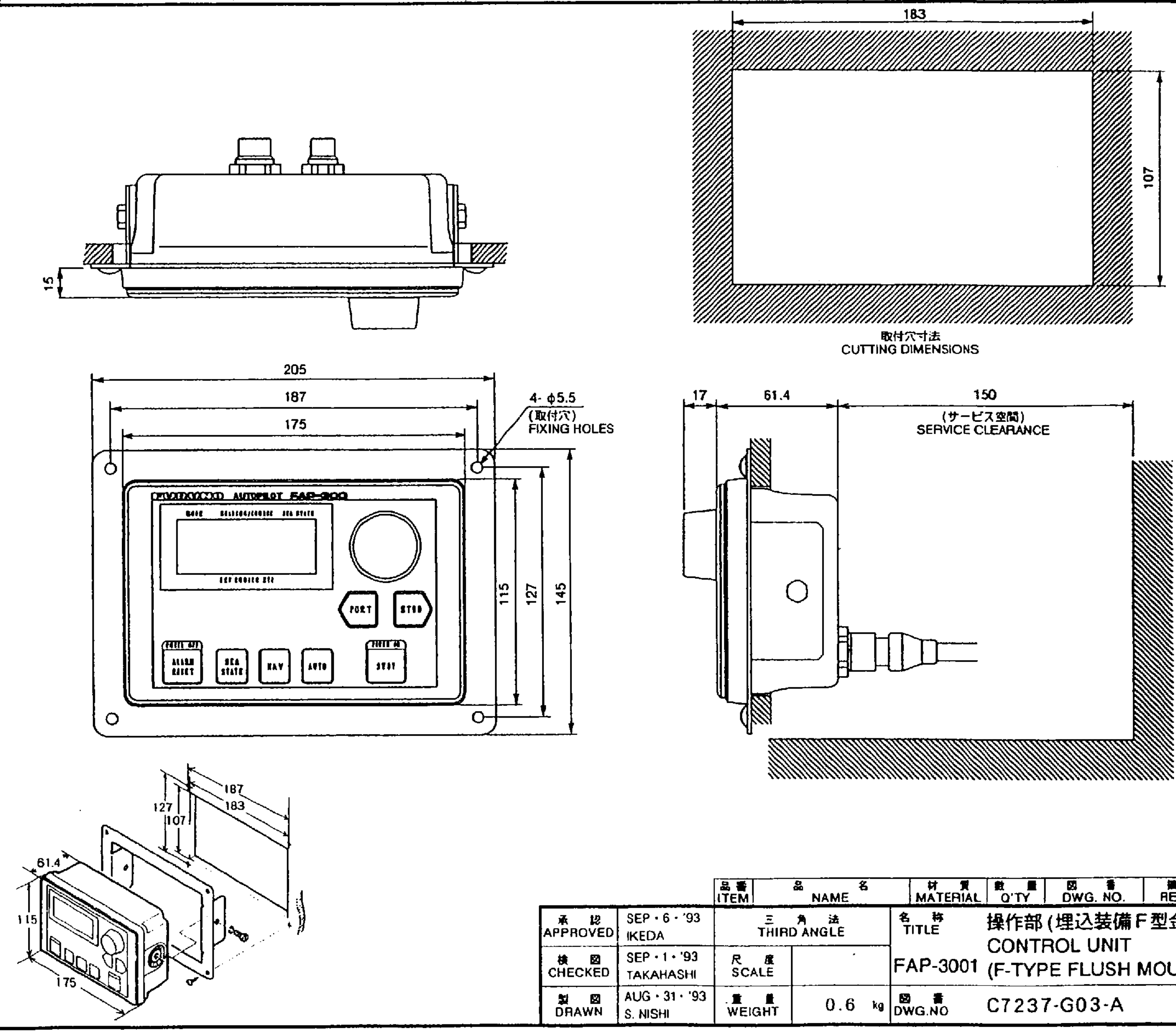
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	SEP・6・'93 M. IKEDA	三角法 THIRD ANGLE		名称 TITLE	操作部（埋込装備S型金具） CONTROL UNIT (S-TYPE FLUSH MOUNT)
検図 CHECKED	SEP・1・'93 TAKAHASHI	尺度 SCALE		FAP-3001	
製図 DRAWN	AUG・31・'93 S. NISHI	重量 WEIGHT	0.6 kg	図番 DWG.NO	C7237-G02-A

FAP-300

FURUNO ELECTRIC CO., LTD.

FURUNO

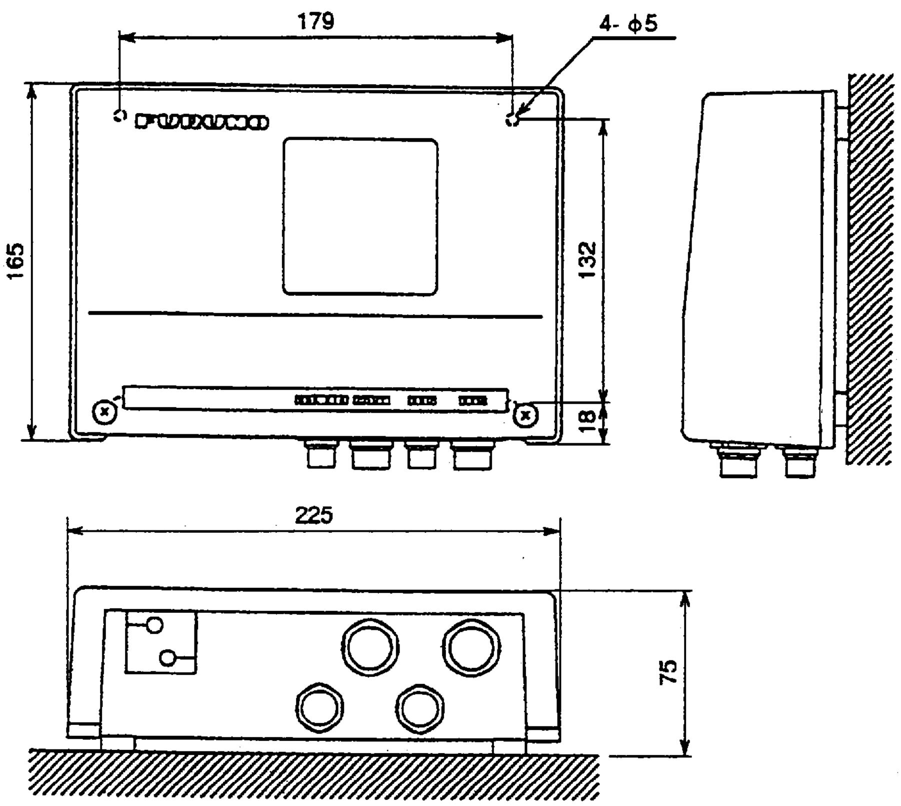


品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	SEP・6・'93 IKEDA	三角法 THIRD ANGLE		名称 TITLE	操作部(埋込装備F型金具) CONTROL UNIT
検図 CHECKED	SEP・1・'93 TAKAHASHI	尺度 SCALE		FAP-3001	(F-TYPE FLUSH MOUNT)
製図 DRAWN	AUG・31・'93 S. NISHI	重量 WEIGHT	0.6 kg	図番 DWG.NO	C7237-G03-A

FAP-300

FURUNO ELECTRIC CO., LTD.

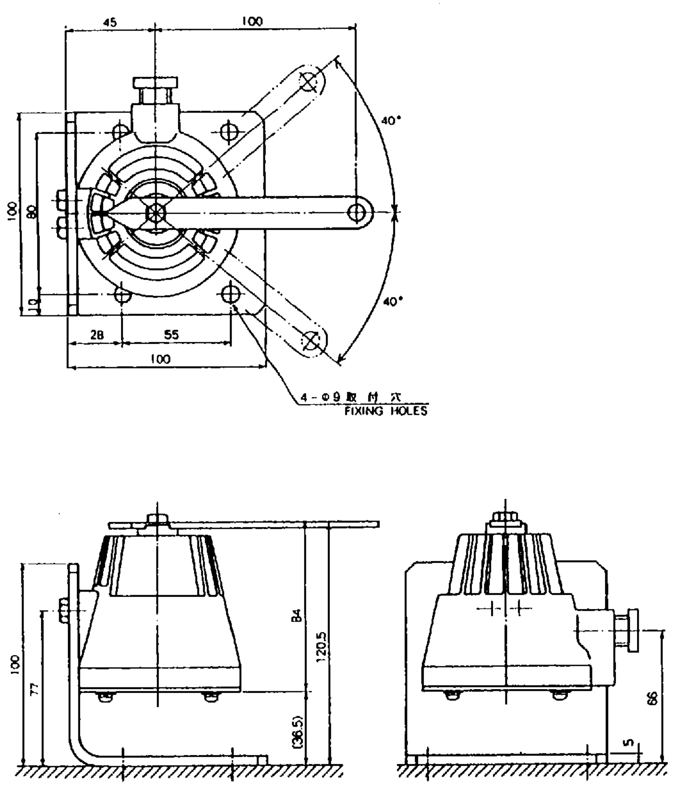


FAP-300	品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	SEP・6・'93 M. IKEDA	三角法 THIRD ANGLE		名称 TITLE	制御部
検図 CHECKED	SEP・1・'93 TAKAHASHI	尺度 SCALE		FAP-3002	PROCESSOR UNIT
製図 DRAWN	AUG・26・'93 S. NISHI	重量 WEIGHT	0.8 kg	図番 DWG.NO	C7237-G04-A

FURUNO ELECTRIC CO., LTD.

FURUNO



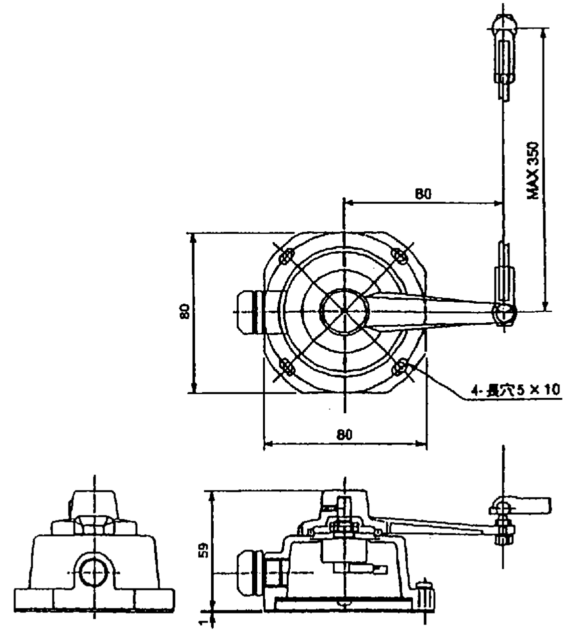
FAP 330

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	JUN·15·'92 T.TAKAKO	三角法 THIRD ANGLE	名称 TITLE FAP-6101 追従発信器 RUDDER REFERENCE UNIT
検図 CHECKED	JUN·15·'92 N. SAITO	尺度 SCALE	
製図 DRAWN	JUN·15·'92 [illegible]	重量 WEIGHT 1.6 kg	図番 DWG.NO C7235 – G07 – A

FURUNO ELECTRIC CO., LTD.

FURUNO

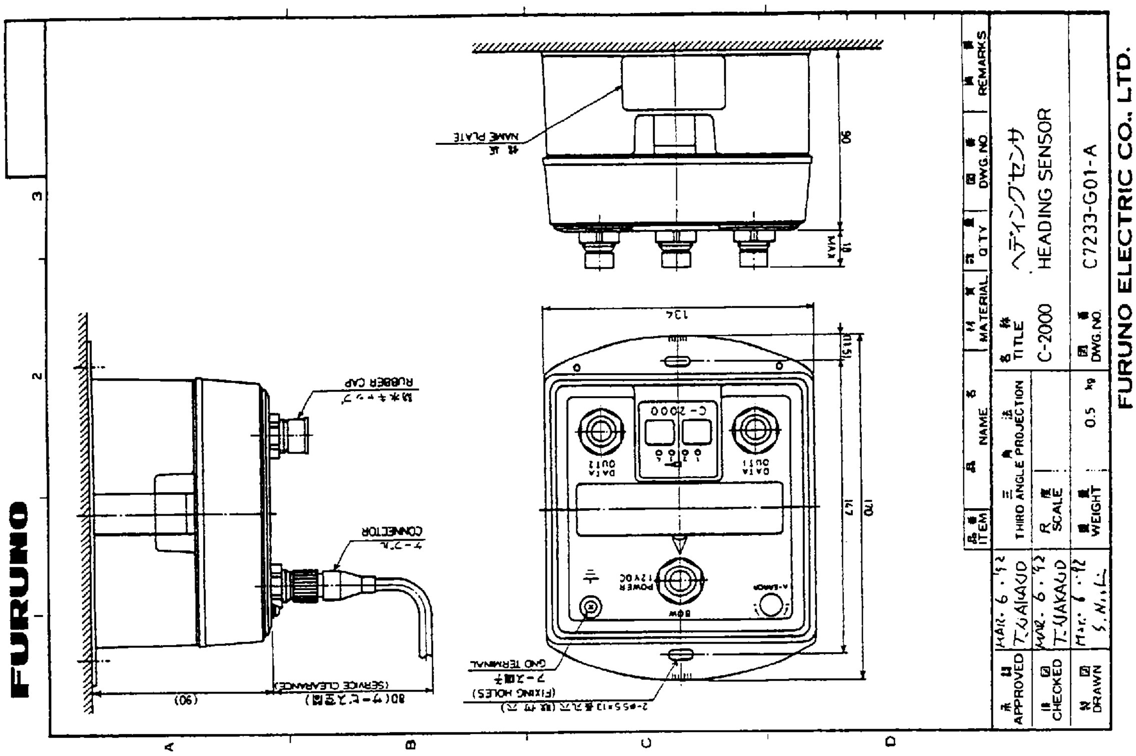


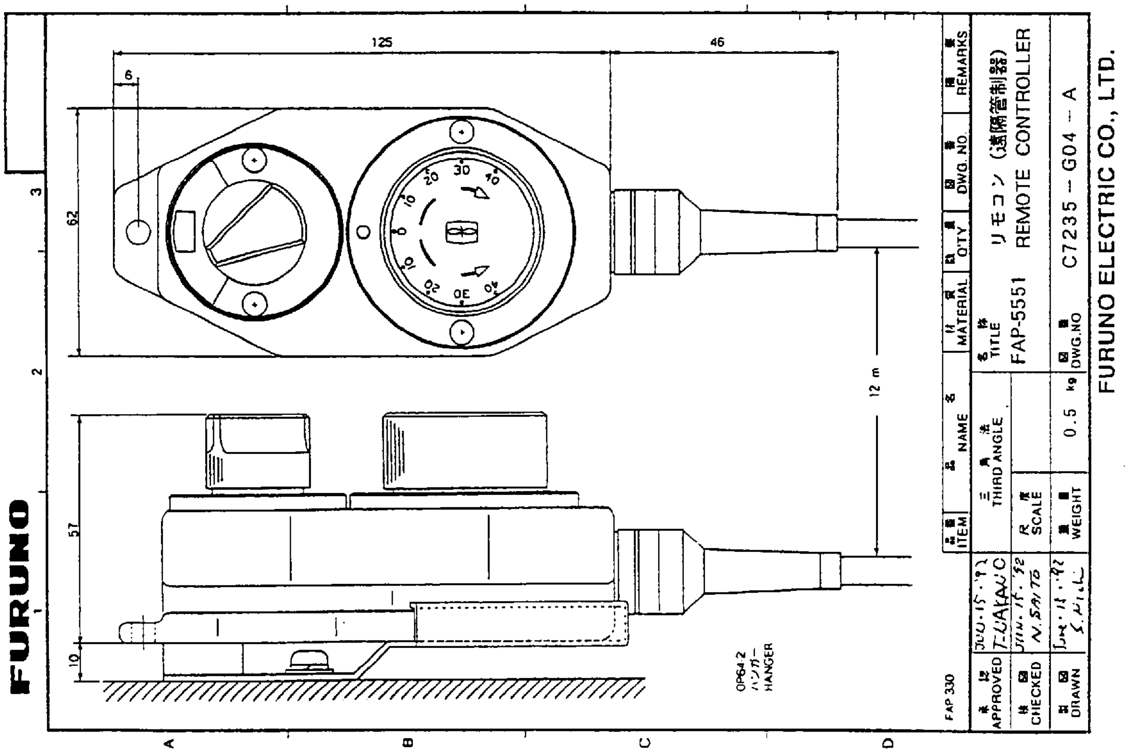
FAP-300

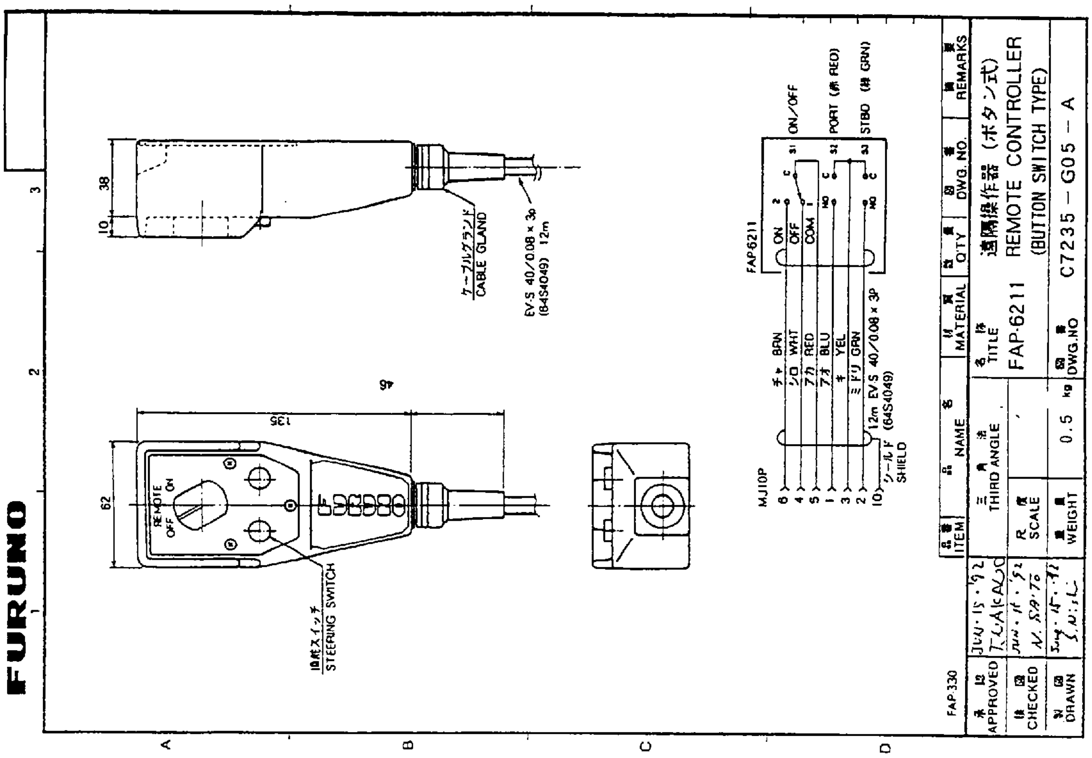
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

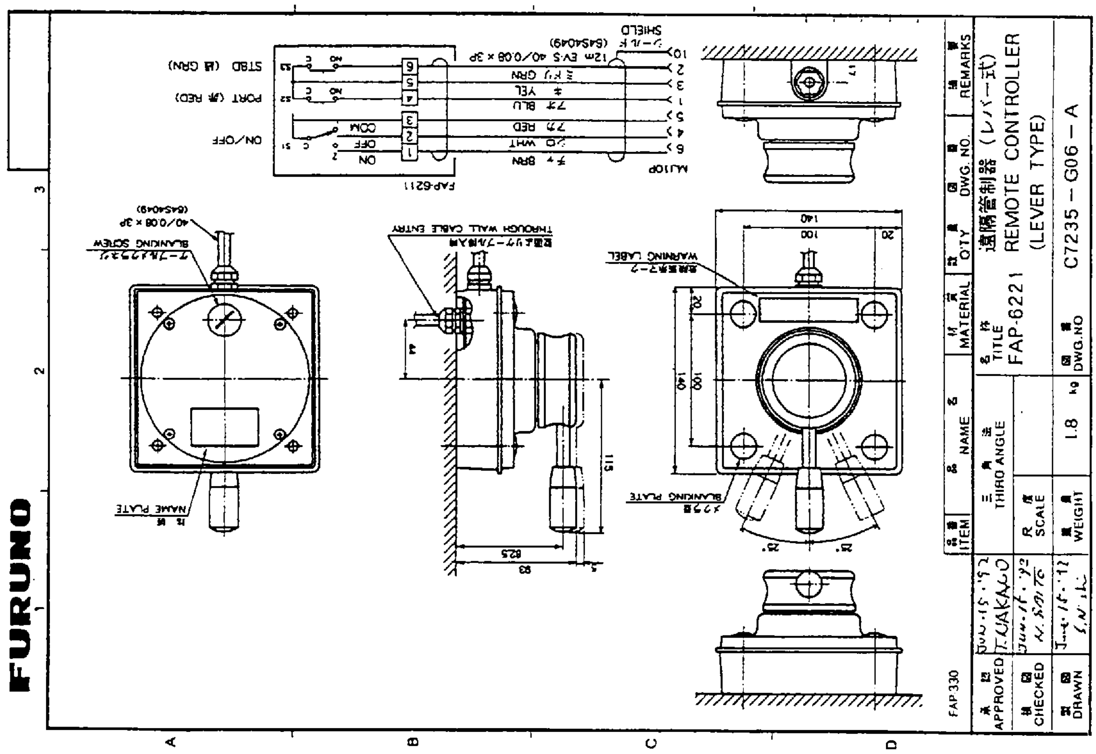
承認 APPROVED	SEPT·6·'93 M. IKEDA	三角法 THIRD ANGLE	名称 TITLE FAP-6110 追従発信器 RUDDER REFERENCE UNIT
検図 CHECKED	SEPT·1·'93 TAKAHASHI	尺度 SCALE	
製図 DRAWN	AUG·26·'93 S. NISHI	重量 WEIGHT 0.2 kg	図番 DWG.NO C7237-G05-B

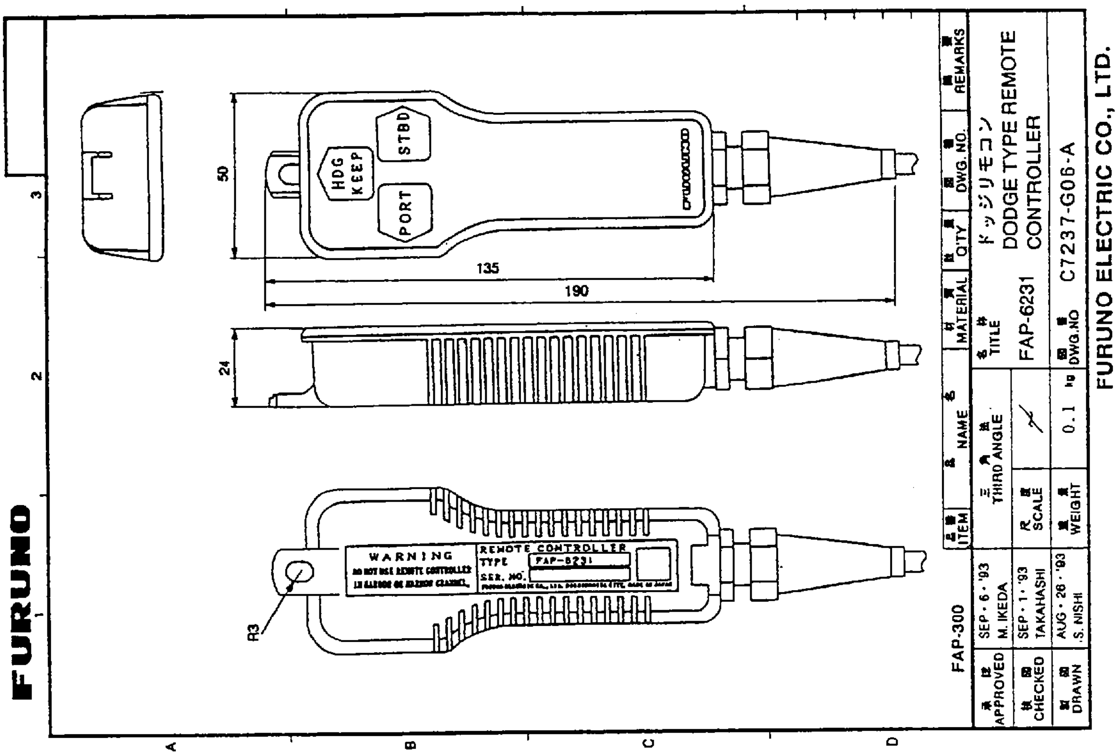
FURUNO ELECTRIC CO., LTD.

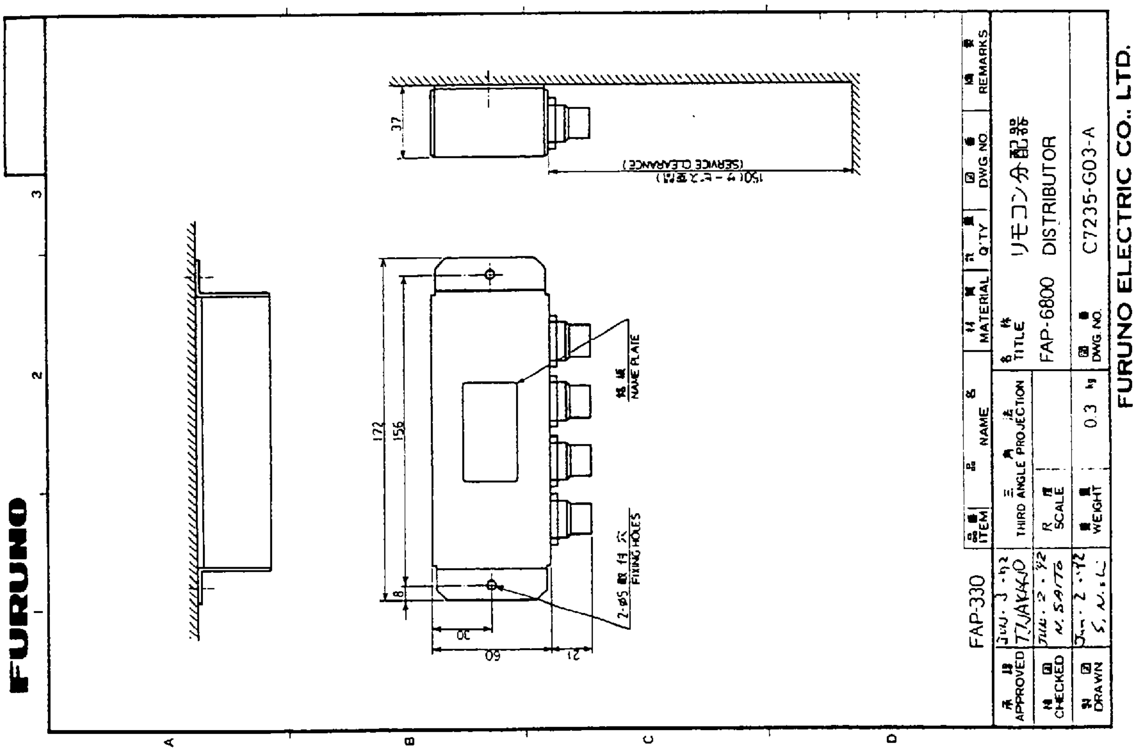

FURUNO
NAME PLATE
RUBBER CAP
CONNECTOR
GND TERMINAL
FIXING HOLES
SERVICE CLEARANCE
POWER
12VDC
DATA OUT1
DATA OUT2
C-2000
134
147
170
90
THIRD ANGLE PROJECTION
0.5 kg
C-2000
ヘディングセンサ
HEADING SENSOR
C7233-G01-A
FURUNO ELECTRIC CO., LTD.

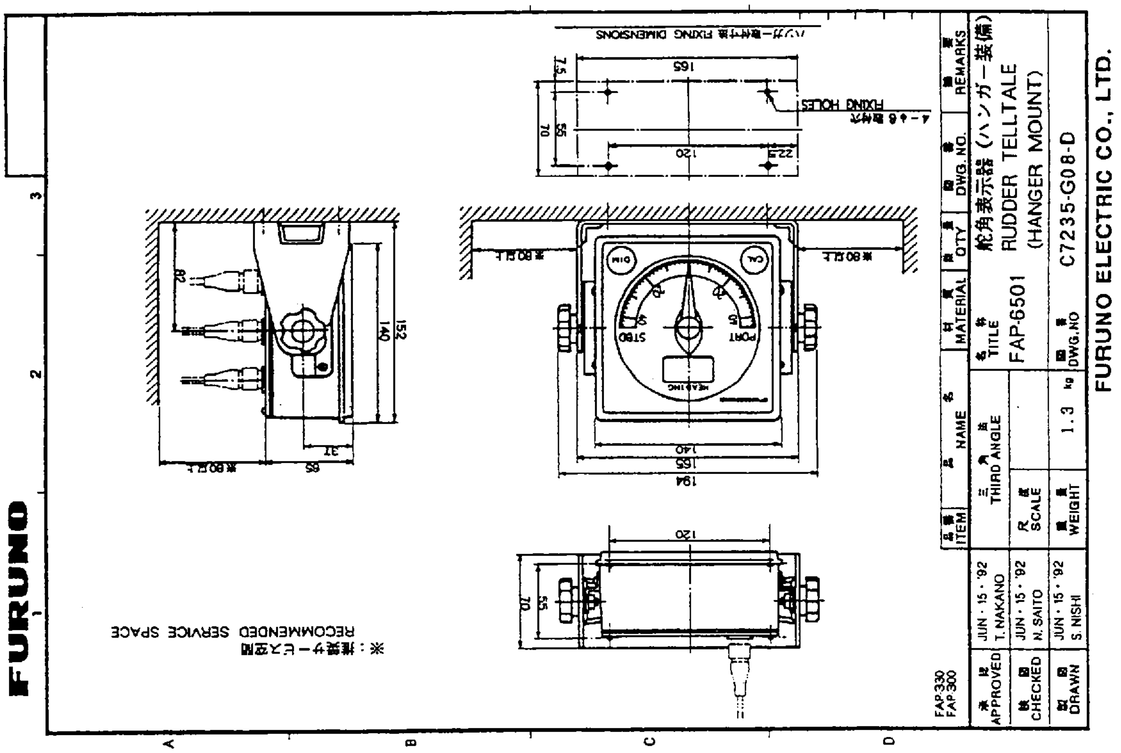

FURUNO
125
46
6
62
57
10
12 m
HANGER
FAP 330
THIRD ANGLE
0.5 kg
FAP-5551
リモコン (遠隔管制器)
REMOTE CONTROLLER
C7235 – G04 – A
FURUNO ELECTRIC CO., LTD.

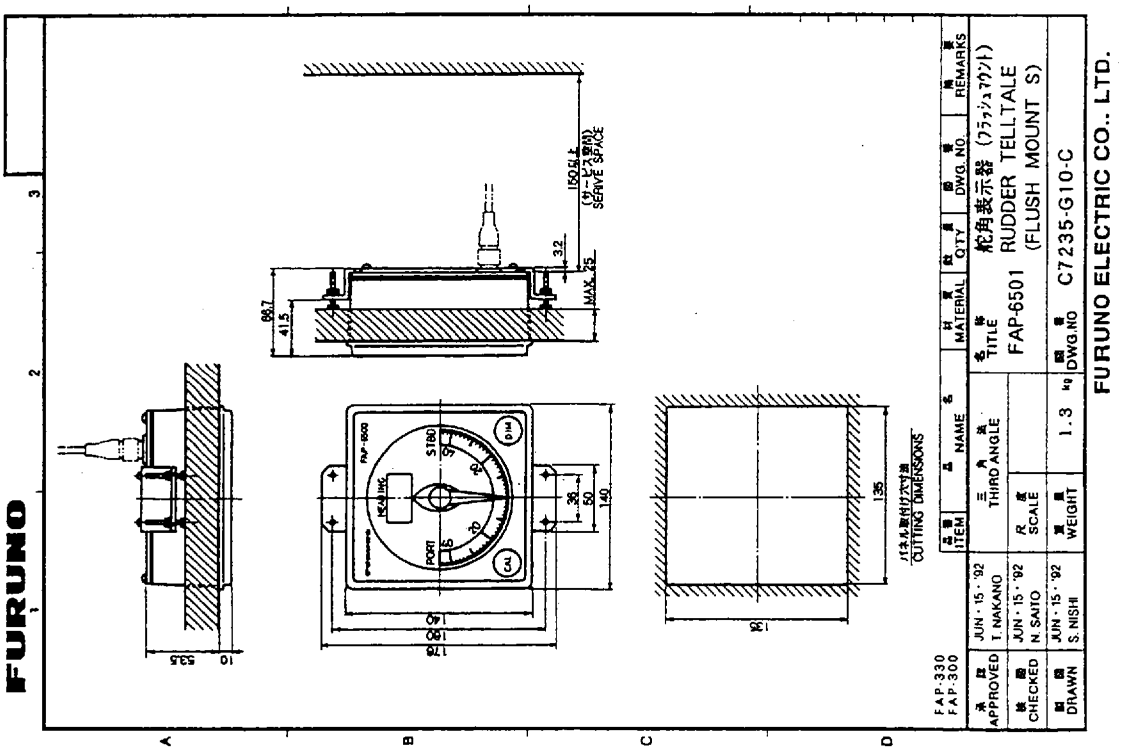

FURUNO
遠隔操作器（ボタン式）
REMOTE CONTROLLER
(BUTTON SWITCH TYPE)
FAP-6211
C7235 - G05 - A
FURUNO ELECTRIC CO., LTD.
操舵スイッチ
STEERING SWITCH
ケーブルグランド
CABLE GLAND
EV·S 40/0.08 × 3p (64S4049) 12m
REMOTE
OFF
ON
MJ10P
FAP-6211
ON/OFF
PORT (赤 RED)
STBD (緑 GRN)
BRN
WHT
RED
BLU
YEL
GRN
シールド
SHIELD
FAP 330
APPROVED
CHECKED
DRAWN
THIRD ANGLE
SCALE
WEIGHT
0.5 kg
ITEM
NAME
MATERIAL
QTY
DWG. NO.
REMARKS
TITLE
DWG.NO


FURUNO
遠隔舵制器（レバー式）
REMOTE CONTROLLER
(LEVER TYPE)
FAP-6221
C7235 - G06 - A
FURUNO ELECTRIC CO., LTD.
NAME PLATE
BLANKING SCREW
THROUGH WALL CABLE ENTRY
WARNING LABEL
BLANKING PLATE
MJ10P
FAP-6211
ON/OFF
PORT (赤 RED)
STBD (緑 GRN)
SHIELD
FAP 330
APPROVED
CHECKED
DRAWN
THIRD ANGLE
SCALE
WEIGHT
1.8 kg
ITEM
NAME
MATERIAL
QTY
DWG. NO.
REMARKS
TITLE
DWG.NO

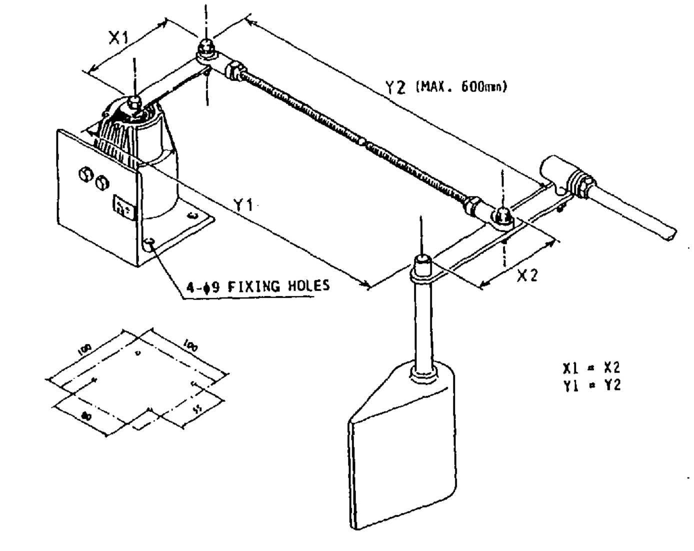

FURUNO
FAP-300
WARNING
REMOTE CONTROLLER
TYPE FAP-6231
SER. NO.
HDG KEEP
STBD
PORT
R3
50
135
190
24
ITEM
NAME
MATERIAL
Q'TY
DWG. NO.
REMARKS
APPROVED SEP. 6 '93 M. IKEDA
CHECKED SEP. 1 '93 TAKAHASHI
DRAWN AUG. 26 '93 S. NISHI
THIRD ANGLE
SCALE
WEIGHT 0.1 kg
TITLE
FAP-6231
ドッジリモコン
DODGE TYPE REMOTE CONTROLLER
DWG.NO C7237-G06-A
FURUNO ELECTRIC CO., LTD.


FURUNO
FAP-330
37
150 (SERVICE CLEARANCE)
172
156
8
2-φ5 FIXING HOLES
30
60
21
NAME PLATE
ITEM
NAME
MATERIAL
Q'TY
DWG. NO.
REMARKS
APPROVED
CHECKED
DRAWN
THIRD ANGLE PROJECTION
SCALE
WEIGHT 0.3 kg
TITLE
FAP-6800
リモコン分配器
DISTRIBUTOR
DWG. NO. C7235-G03-A
FURUNO ELECTRIC CO., LTD.


FURUNO
RUDDER TELLTALE
(HANGER MOUNT)
舵角表示器（ハンガー装備）
FAP-6501
C7235-G08-D
FURUNO ELECTRIC CO., LTD.
RECOMMENDED SERVICE SPACE
FIXING HOLES
FIXING DIMENSIONS
FAP330
FAP300
APPROVED
JUN · 15 · '92
T. NAKANO
CHECKED
JUN · 15 · '92
N. SAITO
DRAWN
JUN · 15 · '92
S. NISHI
THIRD ANGLE
SCALE
WEIGHT
1.3 kg
ITEM
NAME
MATERIAL
QTY
DWG. NO.
REMARKS
TITLE
DWG.NO
STBD
PORT
HEADING
DIM
CAL
194
165
140
120
152
70
55
75
22
65
31
82


FURUNO
RUDDER TELLTALE
(FLUSH MOUNT S)
舵角表示器（フラッシュマウント）
FAP-6501
C7235-G10-C
FURUNO ELECTRIC CO., LTD.
CUTTING DIMENSIONS
SERVE SPACE
MAX. 25
FAP-330
FAP-300
APPROVED
JUN · 15 · '92
T. NAKANO
CHECKED
JUN · 15 · '92
N. SAITO
DRAWN
JUN · 15 · '92
S. NISHI
THIRD ANGLE
SCALE
WEIGHT
1.3 kg
ITEM
NAME
MATERIAL
QTY
DWG. NO.
REMARKS
TITLE
DWG.NO
STBD
PORT
HEADING
DIM
CAL
176
160
140
135
50
38
10
53.5
88.7
41.5
3.2

FURUNO



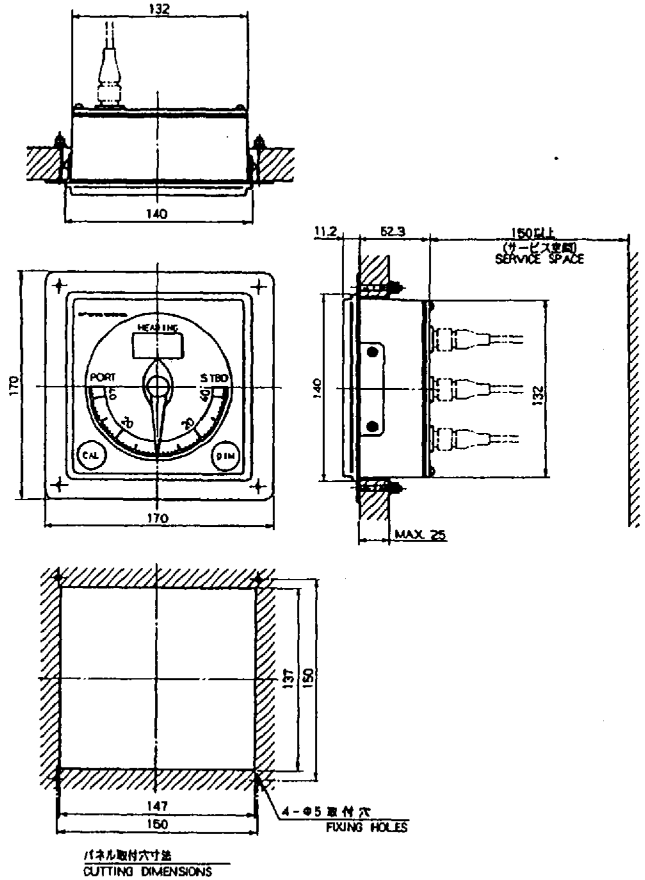
(The unit may be installed at either side of the rudder.)

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

承認 APPROVED	NOV·13·'90 T.NAKANO	三角法 THIRD ANGLE PROJECTION	名称 TITLE RUDDER REFERENCE UNIT INSTALLATION
検図 CHECKED	NOV·13·'90 N.SAITO	尺度 SCALE	
製図 DRAWN	Nov·13·'90 S.Nishi	重量 WEIGHT kg	図番 DWG.NO. E7227-Y01-A

FURUNO ELECTRIC CO., LTD.

FURUNO



FAP-330
FAP-300

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	JUN·15·'92 T. NAKANO	三角法 THIRD ANGLE	名称 TITLE FAP-6501 舵角表示器 (フラッシュマウント F) RUDDER TELLTALE (FLUSH MOUNT F)
検図 CHECKED	JUN·15·'92 N. SAITO	尺度 SCALE	
製図 DRAWN	JUN·15·'92 S. NISHI	重量 WEIGHT 1.4 kg	図番 DWG.NO C7235-G09-C

FURUNO ELECTRIC CO., LTD.